Late Pliocene (Villafranchian) mammals from Sarikol Tepe, Ankara, Turkey

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With 23 figures and 4 tables

Kurzfassung

Die pliozänen Wirbeltierreste von Sarikol Tepe in der Türkei werden hier untersucht. Die beschriebene Säugertierfauna umfasst zehn Taxa: *Borsodia* sp., *Eucyon* cf. *odessanus*, *Pliocrocuta perrieri arambourgi*, *Homotherium* sp., *Equus stenonis*, *Paracamelus* cf. *alutensis*, cf. *Pliotragus*, *Gazellospira* cf. *torticornis*, *Gazella* sp. und Bovidae indet. und kann in das oberste Pliozän (Villafranchium, MN 17) eingestuft werden. Die „crocutoide" Hyäne von Sarikol Tepe lässt Unterschiede von der typischen *P. perrieri* erkennen und wird zu einer Unterart dieser Spezies erklärt. Der Fundkomplex besteht sowohl aus west-europäischen als auch nordwest-asiatischen Faunenelementen.

Abstract

For the first time a late Pliocene (Villafranchian) fauna is described from Turkey. It contains nine species of large mammals and one rodent: *Borsodia* sp., *Eucyon* cf. *odessanus*, *Pliocrocuta perrieri arambourgi*, *Homotherium* sp., *Equus stenonis*, *Paracamelus* cf. *alutensis*, cf. *Pliotragus*, *Gazellospira* cf. *torticornis*, *Gazella* sp. and Bovidae indet. were determined. The comparison of the "crocutoid" hyaena showed that it differs from the typical *P. perrieri* and its subspecific status is maintained. The faunal assemblage, dated to MN 17, presents similarities with both western European and north-western Asiatic faunas.

1. Introduction

The Sarikol Tepe locality is situated 5.0 km northwest of Kazan town and 2.0 km north of Yassiören village, near the top of a small hill, so-called (Fig. 1). First mammalian remains from this locality were collected by F. Ozansoy in early 1950s. He later reported from there a short faunal list and described *Equus stenonis* and „*Hyaena arambourgi* n. sp." (Ozansoy 1965). In July 1972, a French-Turkish team (E. Heintz, L. Ginsburg, M. Gürbüz and S. Sen) excavated this locality, during one week and collected the materiel described in this paper.

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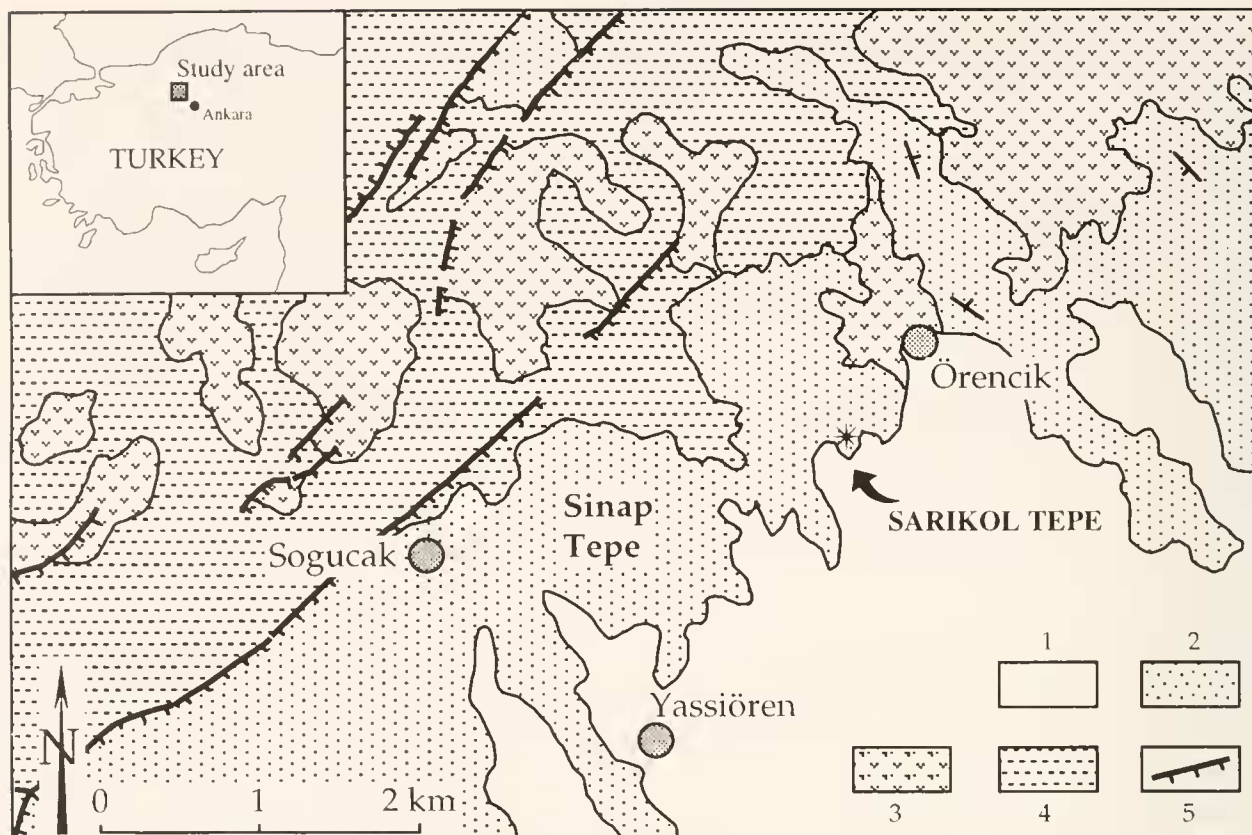
Fig. 1: Geological map of the Sinap area, indicating the location of Sarikol Tepe mammal locality (after ÖNGÜR 1976, modified). 1= Quaternary alluvions; 2= Sinap Tepe Formation; 3= Andesitic rocks of the Galatean Complex; 4= Pazar Formation; 5= Fault.

The stratigraphy of Neogene deposits in the Kazan area was established with some controversies by OZANSOY (1965), ÖNGÜR (1976), SEN (1991) and KAPPELMAN et al. (1996). OZANSOY named the fluvio-lacustrine deposits overlying the southern edge of the Galatean volcanic massif as Sinap Formation, with three members, lower, middle and upper Sinap series. The Sarikol Tepe mammal locality is within the last unit. Field observations showed that this unit recovers the Middle Sinap member on an erosional unconformity. In fact, there is an important time gap between the middle and upper Sinap members: the former yielded only Vallesian mammal faunas, while the latter is dated here as latest Pliocene. The upper Sinap unit is apparently a terrassic deposit probably due to the neighbouring river Ova Çayi (Fig.1).

The upper Sinap unit starts at the base with a thick boulder conglomerate (>10 m); it is recovered in some areas, such as at Sarikol Tepe, by sands and sandy marls including reworked tuffs. The matrix in the fossil locality is a sandy marl with root marks.

Bones are poorly fossilized and bear abundant root marks. They are scattered in the fossiliferous horizon and generally broken. They were apparently not carried much since angles of bones and teeth are still fresh. Most of the specimens belong to large mammals. A few rodent teeth were also collected by washing-screening about 100 kg of sediment. However, the sediments of this locality are too coarse to be suitable to an intensive collecting of small mammals.

To the northwest of Kazan town, the lower and middle members of Sinap Formation yielded rich middle and late Miocene mammal faunas (OZANSOY 1965; SEN 1991; KAPPELMAN et al. 1996). The unique Pliocene locality of the area is Çalta (early MN15; SEN 1998) at some 10 km west to Sarikol Tepe.

In Turkey late Pliocene and early Pleistocene mammal faunas are still poorly known. If from different areas of the country, Plio-Pleistocene small mammalian faunas were described during

1990s, the occurrence of large mammals is mentioned in a few faunal lists given by Sickenberg et al. (1975). Thus, the Sarikol Tepe fauna is the first Villafranchian faunal assemblage ever described from Turkey. As it will be shown below, its composition is new for mammalian evolution in Turkey and even for the whole Aegean area. Its stratigraphic and biogeographic interest should also be emphasized: its divers elements are clearly related with European and northwestern Asiatic faunas.

The fossil material is stored in the collections of MTA in Ankara.

Abbreviations used in the text:

MNHN: Museum national d' Histoire naturelle, Paris

L: length; W: width; ant: anterior lobe; post: posterior lobe; trig: trigonid; tal: talonid; art: articulation; aprx= approximatively. All the measurements are in mm.

2. Systematic Paleontology

Family Arvicolidae Gray 1821

Genus *Borsodia* Janossy & Van der Meulen 1975

Borsodia sp.
(Fig. 2)

Material: 1 M1 dext. (L=2.37, W=1.37), 2 M2 dext. (L=1.82, W=1.28 and L=1.85, W=1.25), 1 M2 sin (L=1.78, W=1.23), 1 M3 sin (L=1.48, W=0.97), 1 m1 sin (L=2.60, W=1.07) and 1 m2 dext (L=1.87, W=1.09). SGT-73-78.

Description and comparison:

These seven specimens are tentatively attributed to a single species of *Borsodia* because of they match in size and dental pattern. Molars are strongly rooted and their reentrant angles are cementless. The enamel band thickness is rather undifferentiated, except in the m1 anteroconid and the posterior part of M3 where it is thinner.

Upper molars are two rooted; however, M1 has a large anterior root with two cavities and a deep lingual groove indicating the recent confluence of the anterior and lingual roots. The enamel tracks are low. Enamel free areas are observed on the anterolingual part of M1, on the posterior edge of M1 and M2, and on the anterolabial angle of M2 and M3. The reentrant angles of m1 and M2 are narrow and strongly curved backward. This character is not observed in *Mimomys* Major 1902 which has wide and shallower reentrant angles, and they are not strongly curved backward as in the Sarikol Tepe specimens. The same characters also differentiate the Sarikol Tepe specimens from *Cseria* Kretzoi 1959, which is considered as a genus derived from *Mimomys* or included in this as a subgenus.

The unique M3 has no enamel island. The labial reentrant angle is wide and transverse. The anterolingual reentrant angle is short and wide. This specimen differs from all *Mimomys* and *Cseria* by its short anterolingual reentrant angle which is as deep as the posterolingual angle in these genera.

The unique m1 is quite worn. The *Mimomys*-fold is present, but its anterior triangle is tenuous. The anteroconid is short, and its labial wall lacks the enamel band. The enamel band is also lacking on the labial corner of the posterolophid. The dentine tracks are low, except on the labial side of the anteroconid. The HH index of Rabeder (1981) cannot be measured because of the advanced wear (Fig. 2).
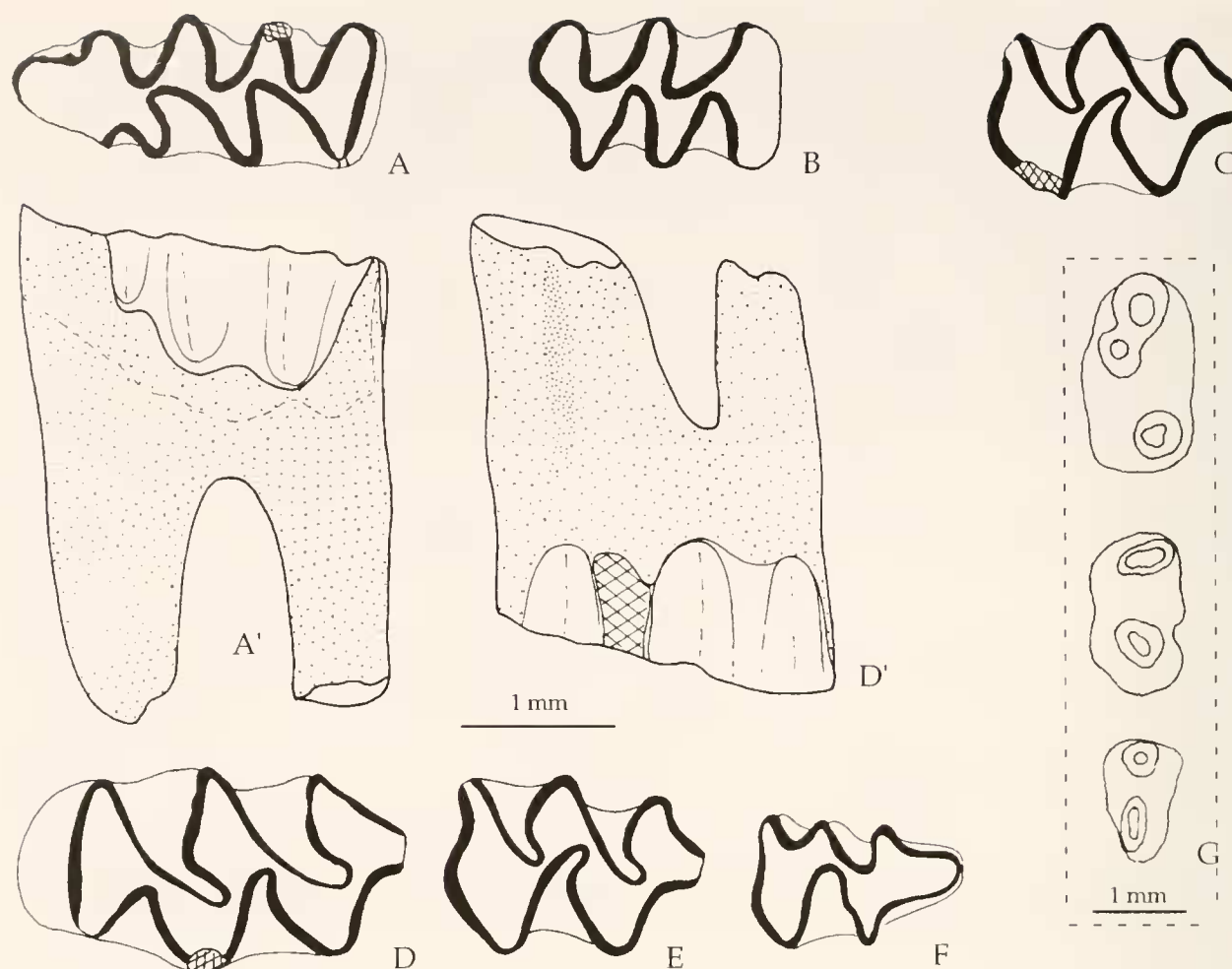
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Fig. 2: *Borsodia* sp. from Sarikol Tepe, Turkey. A: m1; A': m1, labial view; B: m2; C and E: M2; D: M1; D': M1, lingual view; F: M3; G: root view of M1, M2 and M3.

Differences between *Borsodia* and other contemporary arvicolids have been sort out by TESAKOV (1993). More than 20 species were referred to this genus, although many of them are apparently synonymous. The geographic distribution of *Borsodia* covers large areas from China and Mongolia to central Europe and England, along the late Pliocene steppe belt of Eurasia. Stratigraphic distribution of this genus is during the Villanyian and early Biharian (approximately between 3.0 and 1.5 Ma).

In the evolutionary process of this genus, TESAKOV (1993) identified three "stages of dental evolution". The oldest and primitive forms are known from the early Villanyian of northeastern Europe: *B. steklovi* (ZAZHIGIN 1980) and *B. novoasovica* (TOPACHEVSKI and SKORIK 1977). In this group, m1 has asymmetric anteroconid, posteriorly situated *Mimomys*-fold and a deep islet fold in front of this structure. M3 has an anterior islet or a deep anterolabial fold. In these species, the dentine tracks are very low.

The second stage, so-called "intermediate stage", is better represented by *B. praehungarica* (SCHEVSCHENKO 1965) to which also included the three new species described by RABEDER (1981) from the late Villanyian of Austria. In this group, the *Mimomys*-fold is shifted anteriorly, the anteroconid is symmetrical in shape, the third labial angle became tenuous on m1, and on M3 the anterolabial fold is shallow and the posterior loph is elongated. The dentine tracks are higher than in the first group. The characters of the Sarikol Tepe specimens fit with that of the "intermediate stage".

In the representatives of the third stage, there is a notable hypsodonty increase, appearance of cement in reentrant angles (*B. fejervaryi*), loss (*B. hungarica*) or strengthening (*B. arankoides*)

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of the *Mimomys*- fold, and even the loss of roots (*B. arankoides*). Dentine tracks are very high and thus the enamel breaks on the attrition surface are important. TESAKOV (1993) recognized two lineages in this group according to the evolutionary trend of some dental structures.

Borsodia is considered as a characteristic element of steppe habitats. In Turkey, *Borsodia* sp. was recorded in two late Villanyian localities, Çatakli and Pekecik, by ÜNAY & de BRUIJN (1998). The Sarikol Tepe specimens are very similar in size and morphology to that of these localities. The few specimens from Sarikol Tepe and the advanced state of attrition in diagnostic teeth do not allow their species determination.

Family Canidae GRAY 1821

Genus *Eucyon* TEDFORD & QIU 1996

Eucyon cf. *odessanus* (ODINZOW 1967)
(Fig. 3)

Synonym: 1991. Canidae indet., SEN, p. 251.

M a t e r i a l : part of right mandibular ramus with m1-m2, SGT-59 (m1: L=17.5, W=6.5, Ltrig=11.6; m2: L=7.1, W=5.0; height of mandibular ramus between m1-m2= 18mm).

Description and comparison:

The single specimen indicates a medium sized canid with alopecoid teeth morphology. The mandibular ramus is rather low and slim. Only the carnassial, the m2 and the root of m3 are preserved. The m1 is elongated with reduced talonid. The paraconid is well separated from the protoconid in lingual view. The protoconid is high and massive. The metaconid is quite strong. Both hypoconid and entoconid are worn. Nevertheless, the former seems to be significantly stronger than the second one. There is not any crest connecting them and therefore, a single valley is present in the talonid. The cingulum, as well as an antero-entoconid are missing. The m2 is very reduced, oval shaped with a weak mesio-labial cingulum. The protoconid and paraconid are well developed, with the second one stronger. The hypoconid is elongated and low, while the entoconid seems to be missing (although both may be fused in a single cuspid wich occupies the disto-labial angle of the tooth) (Fig. 3).

Clearly larger than *Vulpes* (larger teeth dimensions, deeper mandibular ramus) and markedly smaller than *Canis* (Fig. 4), the Sarikol Tepe canid certainly approaches the medium sized representatives of this family with alopecoid teeth morphology, such as *Nyctereutes* and
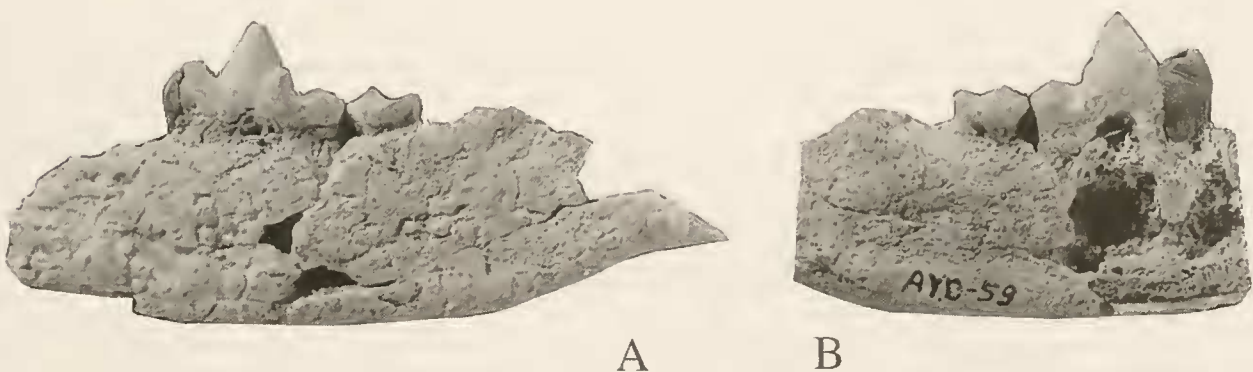

Fig. 3: *Eucyon* cf. *odessanus*, Sarikol Tepe, Turkey. Mandible, SGT-59, A: lingual view, B: labial view. Natural Size.

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Eucyon. It is differentiated from *Nyctereutes* by the smaller m2 comparatively to m1 (Fig. 4), as well as by the talonid structure. The original comparison of the Sarikol Tepe specimen with the mandible of *N. megamastoides* from Perrier (coll. Bravard, MNHN Paris) shows that the latter species is characterized by a more developed talonid on m1, divided in two distinct valleys because of the presence of a crest between the hypoconid and entoconid. Moreover the m2 of *N. megamastoides* possesses a well developed hypoconid and entoconid.

TEDFORD & QIU (1996) include in the new genus *Eucyon*, an important number of Plio-Pleistocene canids, previously referred to *Vulpes*, *Nyctereutes* or *Canis* (TEDFORD & QIU 1996, ROOK 1993). The type species of this genus is *Eucyon davisi* (= *Canis davisi* MERRIAM 1911) from N. America. The lower toothrow of *Eucyon* is characterized by the absence of a crest
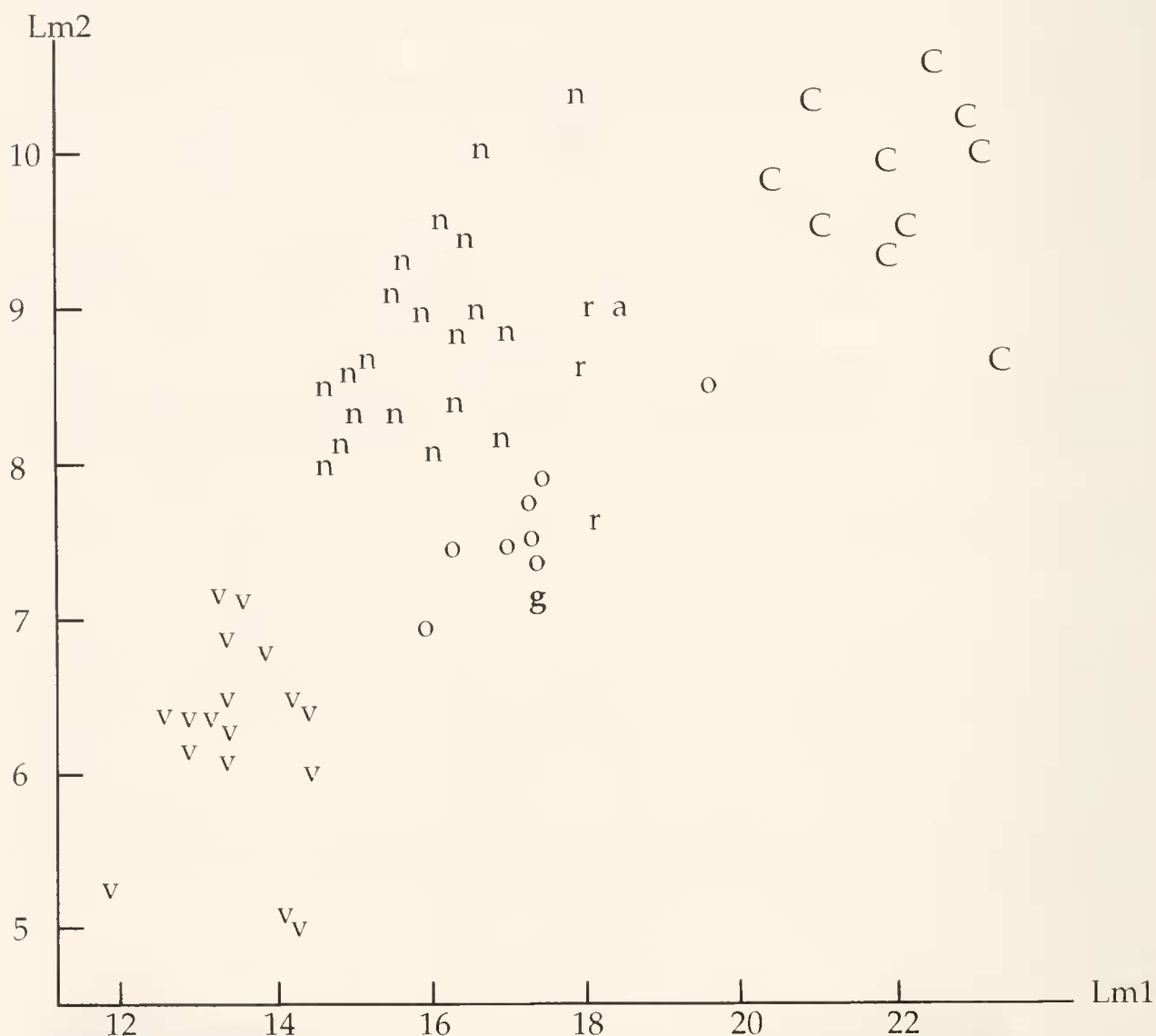

Fig. 4: Scatter diagram, comparing the teeth proportions of several Plio-Pleistocene canids (data from BONIFAY 1971; ADROVER et al. 1976; SORIA & AGUIRRE 1976; KURTEN & CRUSAFONT-PAIRO 1977; KOUFOS 1992; 1993; ROOK 1993, GINSBURG 1998).

g = *Eucyon* cf. *odessanus* from Sarikol Tepe Turkey
o = *Eucyon odessanus* from Odessa Catacombs, Ukraine
r = *Eucyon zhui* and *E. minor* from China
a = *Eucyon adoxus* from Perpignan, France
v = *Vulpes*
n = *Nyctereutes*
C = *Canis etruscus* and *C. arnensis*

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between the hypoconid and the entoconid, as well as by the presence of a second posterior cuspid in p4 (TEDFORD & QIU 1996). The morphology of the studied m1 clearly reminds that of *Eucyon*. As regards the m2 dimensions (Fig. 5), it appears that *Eucyon* has an intermediate position between *Vulpes* and *Nyctereutes*. Moreover, the relative length of m2 compared to m1 is significantly shorter in *Eucyon* (Fig. 4). In both diagrams (Figs. 4, 5) the Sarikol Tepe specimen is placed among the representatives of *Eucyon*, near the Odessa form. According to the description of *E. odessanus* (=*Vulpes odessana* ODINZOW 1967) given by ROOK (1993) the species is characterized by a low and slim mandibular ramus, reduced m2 with weak lingual cingulum and well developed talonid on m1, bearing no crest between hypoconid and entoconid. These features are very similar with those of the Sarikol Tepe canid, in which, however the lingual cingulum and the entoconid of m1 are nearly absent (Fig. 4, 5).

The metrical comparison of the Sarikol Tepe specimen with several species referred to *Eucyon* (Fig. 7) shows a proportional similarity between the studied form and *E. odessanus*, while *E. zhui* and *E. minor* are significantly larger. TEDFORD & QIU (1996) note that the taxonomic status of *E. odessanus* is not so clear and it could be a synonym of *E. davisi*. This species has been recently re-described from the locality of Alatini (N. Greece; SICKENBERG 1972, KOUFOS 1998). Although morphologicaly similar, the Alatini form is proportionally different, especially as concerns the m2 dimensions (Fig. 6). Since a recent study of the *E. odessanus* type material is not yet done, we prefer to considere it as a valid name and we refer the Sarikol Tepe specimen to *Eucyon* cf. *odessanus* (Fig. 6, 7).

Family Hyaenidae GRAY 1869

Genus *Pliocrocuta* KRETZOI 1938

Pliocrocuta perrieri (CROIZET & JOBERT 1828)

Pliocrocuta perrieri arambourgi (OZANSOY 1965)
(Fig. 8)

Synonyms: 1965.*Hyaena arambourgi* OZANSOY, pp. 40-41, Pl. IV, figs. 2,3.
1980.*Pachycrocuta perrieri*, HOWELL & PETTER, p. 599.
1991.*Pliocrocuta perrieri*, WERDELIN & SOLOUNIAS, p. 41.

Lectotype: part of left mandibular ramus with p2-m1, SGT-63 (p2: L=16.4, W=10.9; p3: L=21.3, W=16.4; p4: L=23.5, W=14.8; m1: L=24.6, W=12.2, Ltrigonid=20.3). (Fig. 8-3A,B).

Other specimens: C superior, SGT-61 (L=18.5, W=14.5); P3 dex, SGT-62 (L=24.6, W=14.3); P4 dex - cast, SGT-68 (L=35.6, W=20.5, Lmetacone=13.4); dp3, SGT-64; dp4, SGT-52 (L=20++, W=6.9); part of a right mandibular ramus with c-m1, SGT-79 (canine: L=17.1, W=13.5; p2: L=16.1, W=10.8; p3: L=20.0, W=14.2; p4: L=22.2, W=13.8; m1: L=24.3, W=12.1, Ltrig.=20.2).

Differential diagnosis: Subspecies of *Pliohyaena perrieri* which differs from the typical one by the weaker anterior accessory cusp(id) on P3, p2, p3, the stronger posterior accessory cuspid set close to the base of the main one on p2, p3, the narrower P3 and wider p3, the more reduced talonid on m1 and the anteriorly less extended pterygoid fossae of the mandible.

Description:

In 1965 OZANSOY described a new hyaenid species from the so-called "Sinap Supérieur" locality at Yassiören, Turkey. The material referred by OZANSOY (1965: 40-41, pl.VI, figs 2,3) includes a mandible, an upper toothrow and some isolated teeth; it has never been described
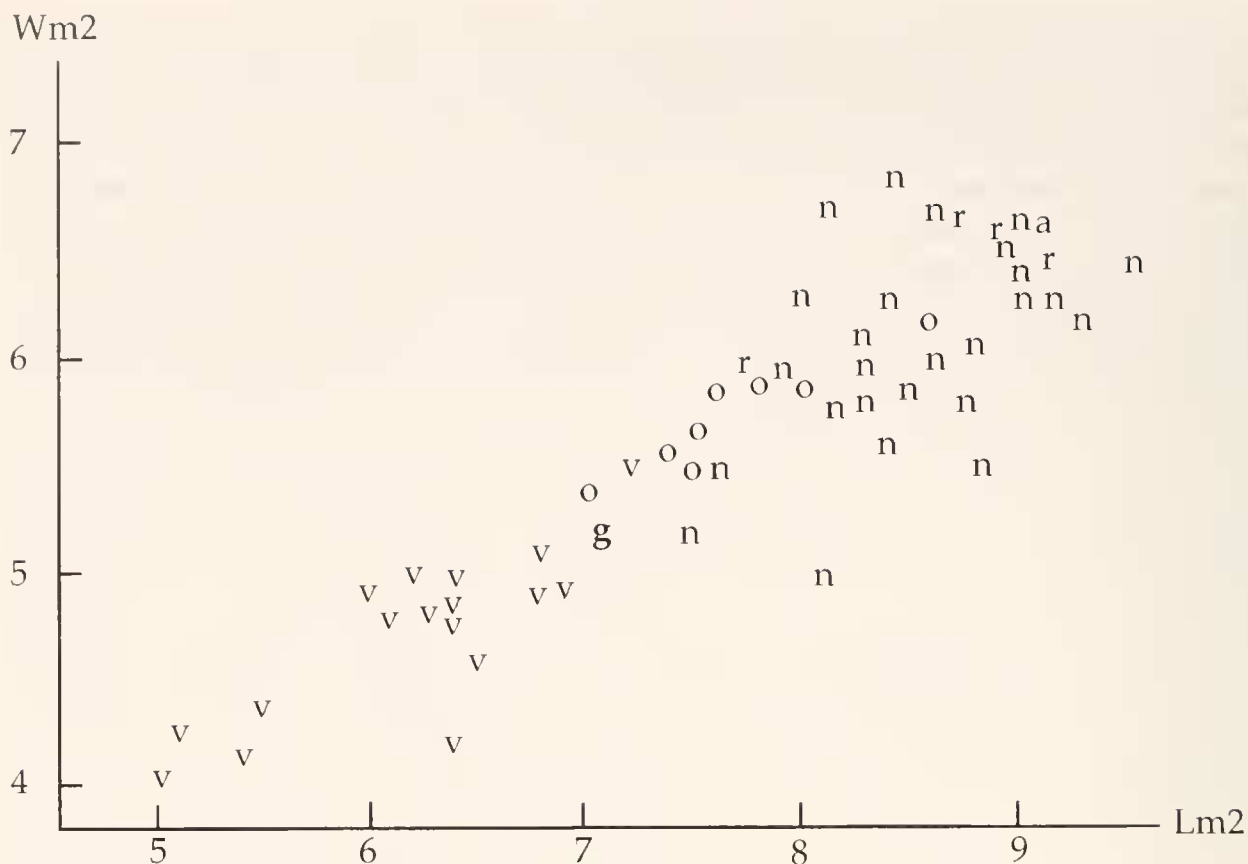
Fig. 5: Scatter diagram, comparing the m2 proportions of several Plio-Pleistocene canids (symbols and references as in Fig. 4).
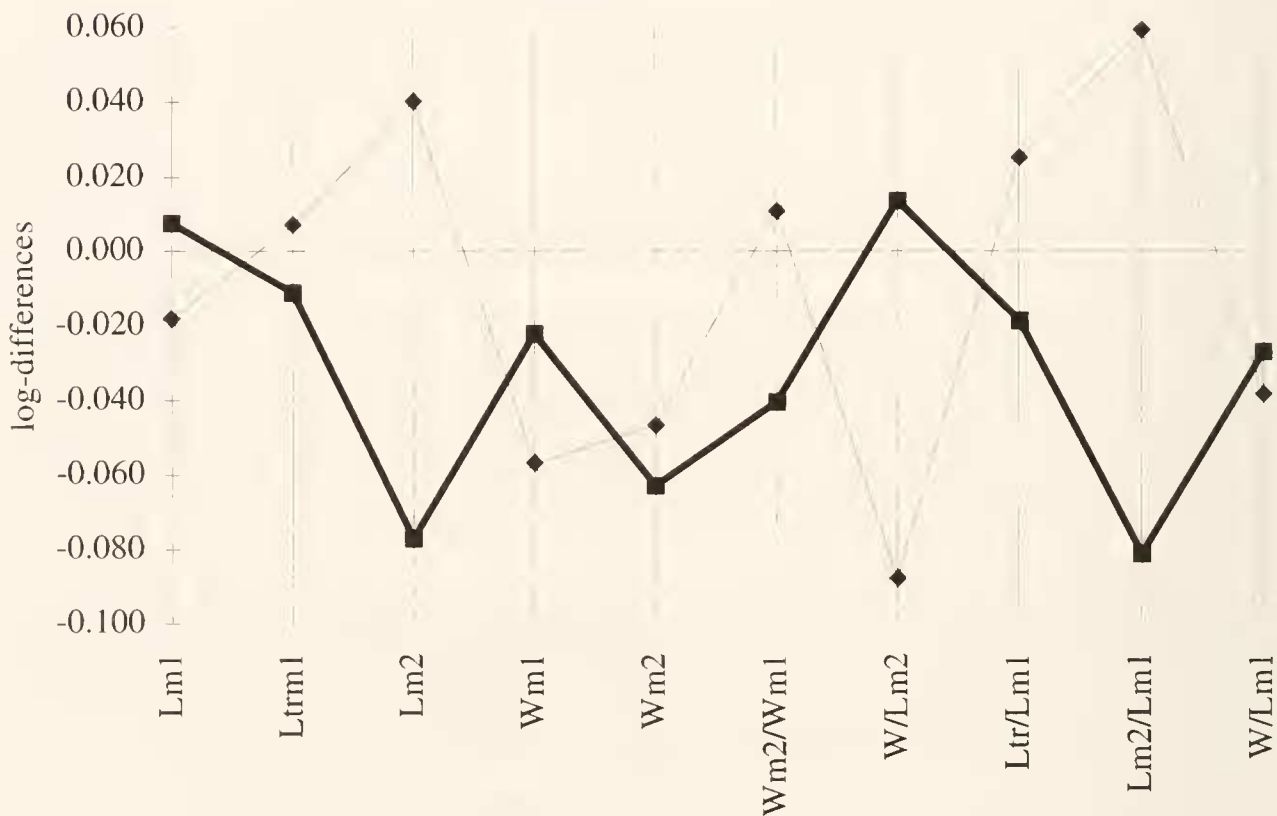

Fig. 6: Logarithmic ratio-diagram, comparing the lower teeth dimensions of *Eucyon* cf. *odessanus* (■) from Sarikol Tepe with *Eucyon davisi* (◆) from Alatini, Greece (data from ROOK 1993; KOUFOS 1998). Standard= *Eucyon davisi* (mean) from Bird Bone, N. America.

and illustrated in detail. The mandible retained here as the lectotype is from OZANSOY's original material. We do not know where the upper toothrow is, or even if there exists one.

The upper canine is very worn but seems to be large; a strong crest in lingual position is present. P3 is narrow with robust main cusp, directed backwards. The mesial crest is strong, while the distal one is moderately developed. The mesio-lingual angle of the crown is strongly developed. The anterior accessory cusp (a.a.c.) is very reduced like a low enlarged elevation at the base of the mesial crest. The posterior accessory cusp (p.a.c.) is well developed and sets close to the base of the distal crest. The mesio-lingual and distal cingula are strong; the lingual one is thick and continuous. The protocone of P4 is anteriorly situated but not extending farther forward than the conical shaped parastyle. A weak mesial crest is present. The paracone is slightly shorter than the metacone, directed backwards. The mesio-lingual face shows two rudimentary cusplets. The disto-lingual cingulum is very thick.

The mandible is rather robust with a high horizontal ramus. Its height behind m1 is 52 mm on the lectotype and 48.7 mm on the other specimen with a corresponding width of 14.5 mm

Fig. 7: Logarithmic ratio-diagram, comparing the lower teeth dimensions of *Eucyon* cf. *odessanus* (■) from Sarikol Tepe with several species of *Eucyon* (data from ROOK 1993). Standard= *Eucyon davisi* (mean) from Bird Bone, N. America.(◆) *E. odessanus* from Odessa Catacombs, Ukraine; (G) *E. minor* from Chao, China; (▲) *E. zhui* from Yushe, China.
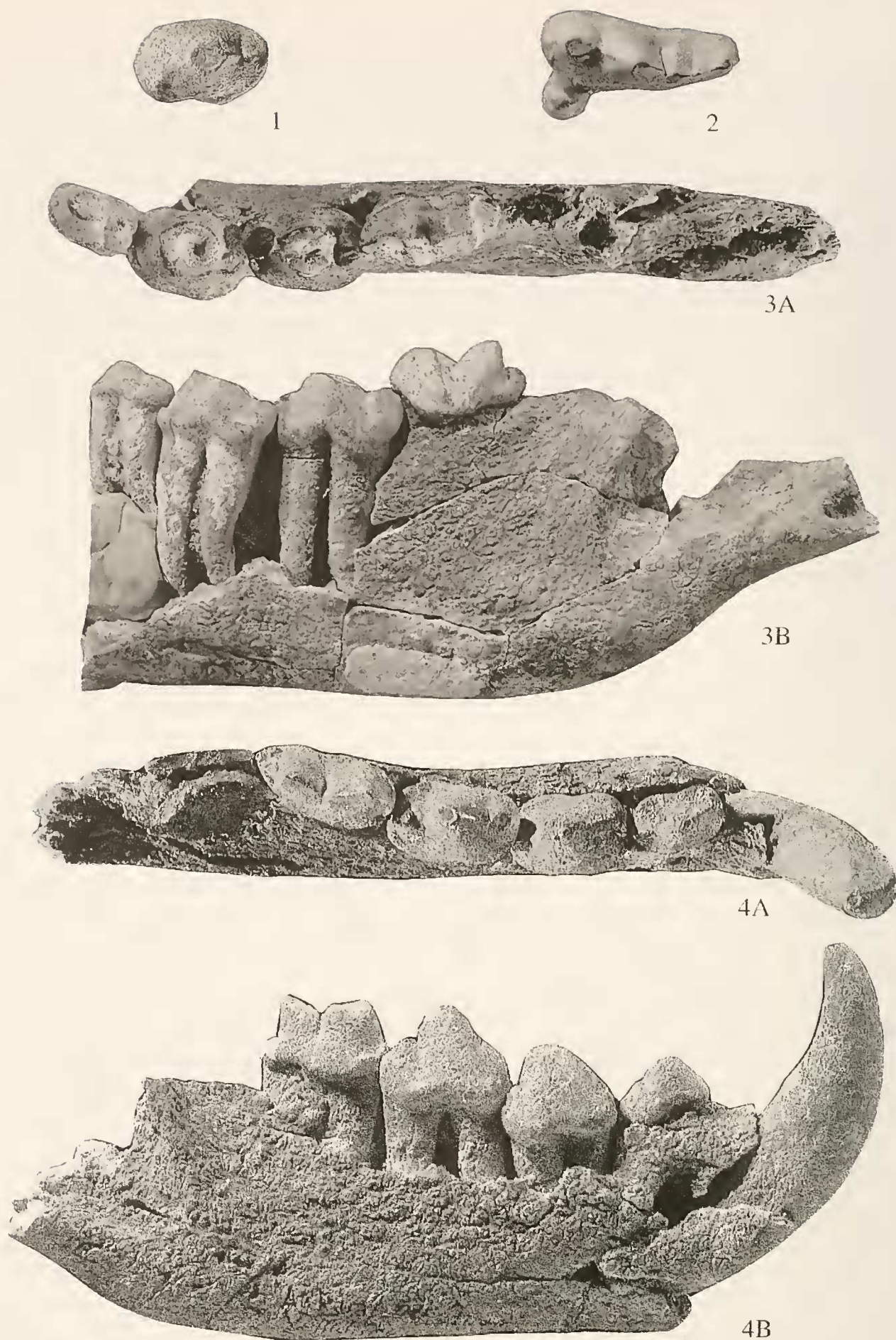
Fig. 8: *Pliocrocuta perrieri arambourgi*, Sarikol Tepe, Turkey. 1: P3, SGT-62 occlusal view; 2: P4, SGT-68 (cast), occlusal view; 3: Mandible sin (lectotype), SGT-63, 3A: occlusal view, 3B: labial view. 4: Mandible dex SGT- 79, 4A occlusal view, 4B: labial view. 3/4 of Natural Size.

and 13.5 mm respectively. The pterygoid fossa is deep; its anterior margin is situated well behind the posterior end of m1. The ventral border of the mandible ascends gradually behind the toothrow.

The lower canine is sharp and has two lingual crests. The second premolar is short and subovoid shaped. There is no real a.a.c. but a small elevation of the mesial cingulum. The p.a.c. is strong and sets close to the base of the main cuspid, at the foot of the worn distal crest. The lingual and labial cingula are low. The distal cingulum is well expressed, especially lingually. p3 is short and wide with a great expansion of the mesio-labial angle. The main cuspid is conical shaped, directed backwards. The a.a.c. is almost absent (similarly to p2), while the posterior one is large, situated close to the base of the main cuspid. A well developed mesial crest is present, while the distal one is worn. The mesial and disto-lingual cingula are strong. p4 is elongated and narrower than p3 with elliptical main cuspid, directed backwards. The a.a.c. is well developed and larger than the posterior one. Both are set close to the base of the main cuspid. The lingual cingulum is almost absent, while the labial one is low and moderately developed. The distal cingulum is strong, elevated and expanded labially and especially lingually. The carnassial is elongated and has a reduced talonid. The paraconid is longer than the protoconid. The hypoconid is small, crest-like, while the entoconid is very small. The metaconid is absent. The dp4 is elongated and narrow. The main cuspid is well developed and the talonid presents a strong hypoconid and a less developed entoconid. The latter one is placed between the hypoconid and the protoconid, being in contact with both.

Comparison:

Some years after the erection of *"Hyaena" arambourgi* by OZANSOY (1965), FICCARELLI & TORRE (1970), SCHÜTT (1971) and more recently HOWELL & PETTER (1980), and WERDELIN & SOLOUNIAS (1991) discussed the Yassiören specimen, concluding that there is no evident reason for its distinction from *Pachycrocuta perrieri* (later referred to *Pliohyaena* KRETZOI 1938 by QIU 1987 and more recently to *Pliocrocuta* KRETZOI 1938 by WERDELIN & SOLOUNIAS 1991).

The origin and systematics of the Eurasian Plio-Pleistocene "crocutoid" hyaenas have been extensively discussed by HOWELL & PETTER (1980), QIU (1987) and WERDELIN & SOLOUNIAS (1991). The general morphological and metrical characters of the studied form (elongated m1 comparatively to p4, elongated trigonid and short talonid on m1, reduced to absent metaconid on m1, broad third premolar, strong mesial crest on P3) approach it to the Plio-Pleistocene "crocutoid" hyaenas referred to *Pliocrocuta* (HOWELL & PETTER 1980, QIU 1987, WERDELIN & SOLOUNIAS 1991).

HOWELL & PETTER (1980) consider *P. pyrenaica* (DEPERET 1890) from Serrat d' en Vacquer (France) as the type species of the genus *Pachycrocuta*, while WERDELIN & SOLOUNIAS (1991) consider this form as a synonym of *Pliocrocuta perrieri*. The original comparison with the material of *P. pyrenaica*, stored in MNHN Paris, shows that the Sarikol Tepe form differs by its larger size (Fig. 9a), the less developed a.a.c. on P3, the stronger a.a.c. set more labially and the stronger lingual cingulum on p4, the stronger p.a.c. on P3, p2, p3, the stronger lingual cingulum on P3,4 and p2-4, the more developed mesial crest on P3, the stronger hypoconid and the absent metaconid on m1.

As regards *Pliocrocuta perrieri* and *Pachycrocuta brevirostris*, the studied form seems to be dimensionally closer to the first species, being markedly smaller than the second one (Fig. 9a). According to HOWELL & PETTER (1980) these two species are closely allied, differentiated only by their size. The original comparison of the Sarikol Tepe specimens with the material of *P. perrieri* stored in MNHN of Paris (including the type specimen n° 834, the mandible referred to *"H. arvernensis"* n° 832, the specimen n° 830: P3-M1 and the specimen n° 835: dp3-m1; collection Croizet) shows interesting differences (Fig. 9, 10).
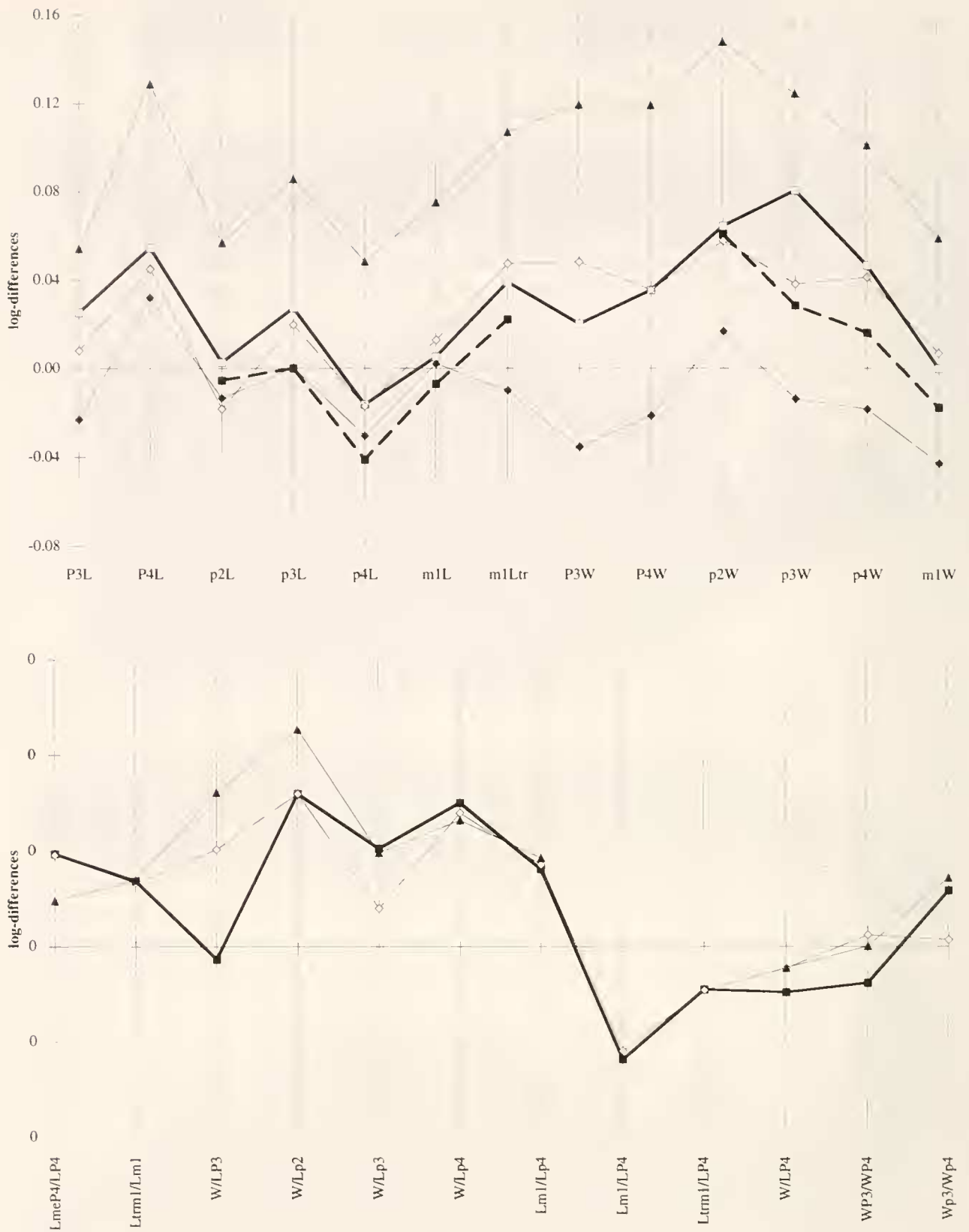
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Fig. 9: Logarithmic ratio-diagram, comparing the teeth dimensions (a) and teeth indices (b) of *Pliocrocuta perrieri arambourgi* from Sarikol Tepe, Turkey with several Plio-Pleistocene "crocutoid" hyaenas. Standard= *P. pyrenaica*, Perpignan, France (orig. meas.)

    ■ *Pliocrocuta perrieri arambourgi* from Sarikol Tepe, Turkey ; 8b: mean values
    ◆ *Pliocrocuta* from Odessa Catacombs, Ukraine
    ◇ *P. perrieri* mean (data from HOWELL & PETTER 1980)
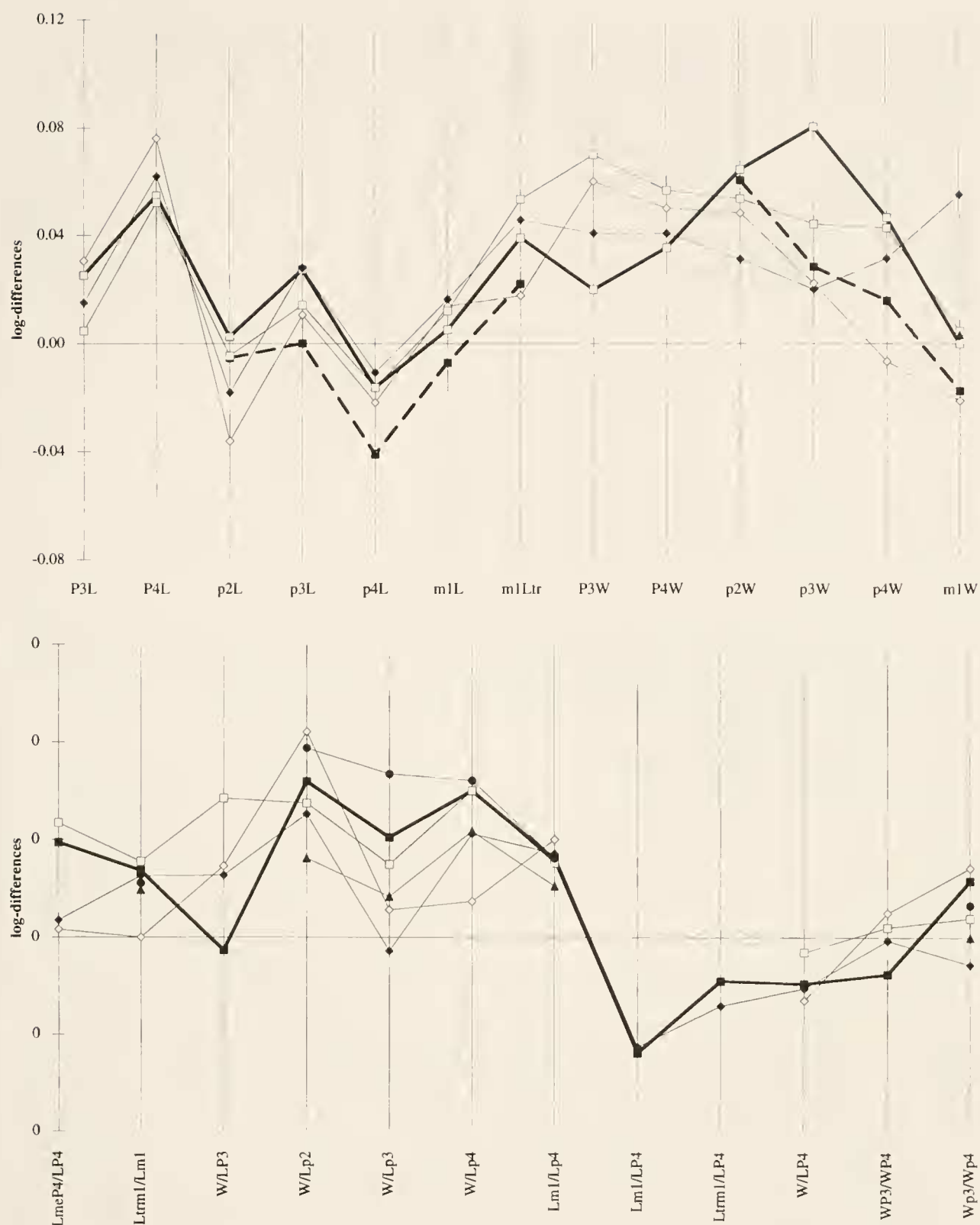   ▲ *P. brevirostris* from Europe mean   "

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Fig. 10: Logarithmic ratio-diagram, comparing the teeth dimensions (a) and teeth indices (b) of *Pliocrocuta perrieri arambourgi* from Sarikol Tepe, Turkey with several local representatives of *P. perrieri*. Standard= *P. pyrenaica*, Perpignan, France (orig. meas.)

■ *Pliocrocuta perrieri arambourgi* from Sarikol Tepe, Turkey; 9b: mean values

❑ *P. perrieri* from St.-Vallier, France (data from HOWELL & PETTER 1980)

✧ *P. perrieri* from Perrier (orig. measur.)

▲ ”*P. arvernensis*” from Perrier, France (orig. meas.)

● *P. perrieri* from Senèze, France (data from HOWELL & PETTER 1980)

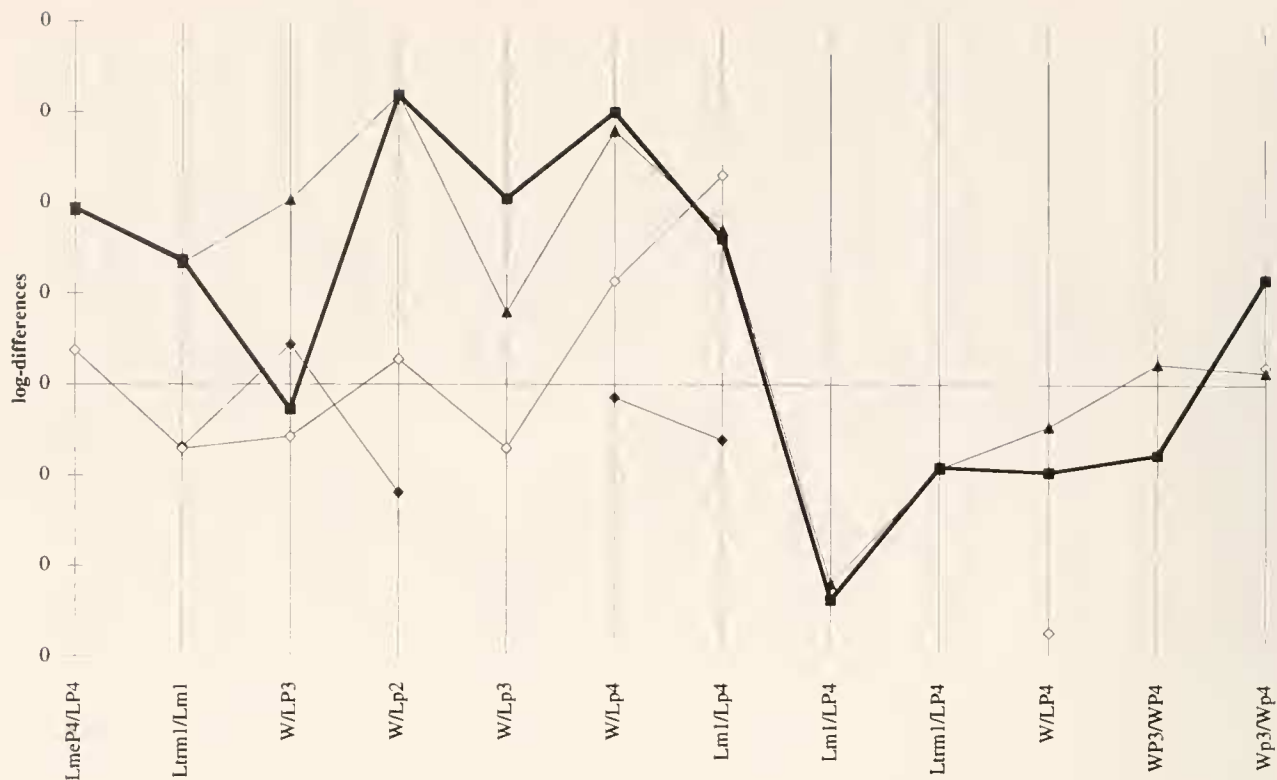◆ *P. perrieri* from Villaroya, Spain (data from HOWELL & PETTER 1980).

Fig. 11: Logarithmic ratio-diagram, comparing the teeth indices of *Pliocrocuta perrieri arambourgi* from Sarikol Tepe, Turkey with several Pliocene representatives of the genus (data from HOWELL & PETTER 1980). Standard= *P. pyrenaica*, Perpignan, France (orig. meas.)

■ *Pliocrocuta perrieri arambourgi* from Sarikol Tepe, Turkey; mean values
◆ La Galera sample
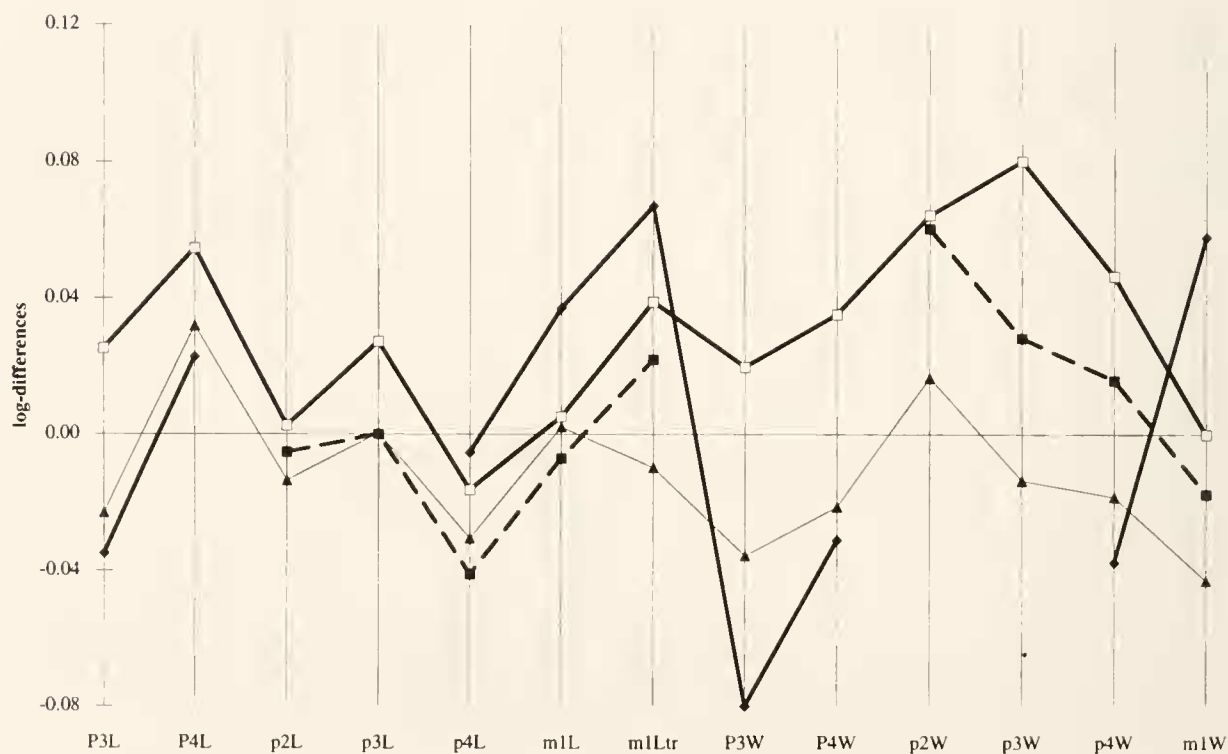◇ Odessa Catacombs sample
▲ *P. perrieri* mean

Fig. 12: Logarithmic ratio-diagram, comparing the teeth dimensions of *Pliocrocuta perrieri arambourgi* from Sarikol Tepe (■), Turkey with *P. perrieri* from Gülyazi, Turkey (◆) and Odessa Catacombs sample (▲) (data from SCHÜTT 1971; HOWELL & PETTER 1980). Standard = *P. pyrenaica*, Perpignan, France (orig. meas.).

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The P3 of *P. perrieri* (spec. 830) is wider (Fig. 9a) with significantly stronger a.a.c. and lingual cingulum. The dp4 of *P. perrieri* (spec. 835) has weaker hypoconid and entoconid comparatively to the Sarikol Tepe form. The first two lower premolars of *P. perrieri* (spec. 834, 832) possess clearly stronger a.a.c. and relatively weaker p.a.c. than the studied form. Moreover, the accessory cuspids of p2-3 of *P. perrieri* do not set close to the base of the main cuspid as in Sarikol Tepe "crocutoid" hyaena. The p4 of the type specimen 834 has weaker disto-labial cingulum than the studied form, although this difference is not so evident in comparison to the specimen 832. The lower carnassial of *P. perrieri* has a more developed talonid, while the hypoconid forms a true cuspid in comparison to the crest-like hypoconid on the Sarikol Tepe m1. In both specimens of *P. perrieri* (834, 832) the metaconid is present (stronger in 832) while it is totally missing from the Sarikol Tepe form.

Concerning the mandibular ramus, there is a clear size variation between the specimens 832 and 834. Nevertheless, both have the anterior margin of the pterygoid fossae situated below the talonid of m1, while in the Sarikol Tepe form it is placed well behind the carnassial. A similar position has been observed in the mandible of *P. pyrenaica*.

In spite of the obvious geographic and chronological variability of *P. perrieri* (HOWELL & PETTER 1980, WERDELIN & SOLOUNIAS 1991), some of the observed morphological differences such as the extension of pterygoid fossae, the development of the accessory cusps (-ids) on the premolars and the structure of m1's talonid, seem to be of greater importance. HOWELL & PETTER (1980) use a number of dental indices in order to express the different tendencies among the *Pliocrocuta / Pachycrocuta* species. A comparison between the Plio-Pleistocene representatives and Sarikol Tepe form, based on these indices, shows four significant differences:

– the index W/L of P3 from Sarikol Tepe is remarkably smaller than that of all the western European representatives of *P. perrieri* (Fig. 10a,b). Similar values are observed only in *P. pyrenaica* and *Pliocrocuta* from Odessa Catacombs, discussed below (Fig. 11).

– the indices W/L for p2 and p3 are significantly larger than those of *P. perrieri* (Figs. 9b, 10a,b). The obtained values even exceed the mean values of *P. brevirostris* (Fig. 9b). From the known samples of *P. perrieri*, only the Senèze form has similar values (Fig. 10b).

– the index Wp3/Wp4 clearly depasses the corresponding values for *P. perrieri*, being closer to the mean values of *P. brevirostris* (Fig. 9b).

– the index WP3/WP4 is markedly smaller than that of *P. perrieri* (Figs. 9b, 10b).

The asymmetric widening of P3 and P4, the increase of the index Wp3/Wp4, the absence of a.a.c. in p2 and p3, the reduction of the talonid and hypoconid on m1 and the absence of metaconid should be considered as derived features of the Sarikol Tepe form. On the other hand the development of pterygoid fossae, the low values of the indices W/L P3 and WP3/WP4, the near absent a.a.c. on P3 and the development of p.a.c. on p4 seem to be archaic features. (Fig. 11)

The Odessa Catacombs hyaenid has been originally described as *Crocuta sivalensis* by VATSKO (1956, in WERDELIN & SOLOUNIAS 1991). HOWELL & PETTER (1980) describe and discuss the status of the Odessa Catacombs form, indicating affinities to *P. pyrenaica* from Roussillon. Later on, WERDELIN & SOLOUNIAS (1991) place this form, as well as the Layna and La Galera ones, in synonymy to *P. perrieri*. A comparison of the studied form with the Odessa one shows a large number of morphological similarities (compare the description of Odessa form given by HOWELL & PETTER 1980: 594-595 with that of the Sarikol Tepe). In fact, the Odessa form differs only by:

- the enlarged a.a.c. on P3,
- the presence of metaconid on m1,
- the development of the cingulum in some teeth and
- the smaller size and teeth proportions (Figs. 9a, 11).

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Although more advanced, the Sarikol Tepe form seems to share strong relationships with the Odessa Catacombs hyaenid. Similar differences between the samples of La Galera, Layna and Odessa from the one part and the typical *P. perrieri* from the other, are also mentioned by WERDELIN & SOLOUNIAS (1991), who, however, conclude that they are not consistent. Nevertheless, the observed differences allow the distinction of the Sarikol Tepe form at subspecific level at least (Fig. 12).

SCHÜTT (1971) described *P. perrieri* from the early-middle Villafranchian locality of Gülyazi (Turkey). The dimensions of P3–P4 and p4 are significantly smaller than those of the Sarikol Tepe and *P. perrieri* and closer to the Odessa form (Fig. 12). The m1 from Gülyazi seems to be very enlarged comparatively to the forms referred to *P. perrieri,* being closer to *P. brevirostris.* Nevertheless, the material from Gülyazi belongs to a young individual and therefore could be not suitable for certain metrical comparison. The presence of a well developed metaconid on m1 and the stronger p.a.c. on p4 differentiate the Gülyazi hyaenid from the Sarikol Tepe one, which seems to be more derived.

Family Felidae GRAY 1821

Genus *Homotherium* FABRINI 1890

Homotherium sp.
(Fig. 13)

M a t e r i a l : P3 sin, SGT-80 (L=18.2, W=9.6); fragment of P4 dex, SGT-81 (Lmetacone= 17.4); p4 dex, SGT-82 (L=20.3, W=10.0).

Description and comparison:

Among the Sarikol Tepe material, three isolated teeth represent a large sabre-toothed felid. The specimen determined as P3 is laterally compressed, but slightly widens posteriorly. It has three cusps, the main one quite robust and high, a.a.c. small but distinct, and p.a.c. thick and surrounded with a posterior and labial cingulum. The crests of all these cusps are sharp and almost aligned centrally along the longitudinal axis. This P3 has two roots, the anterior one longer but thinner than the posterior one.

From P4 only a part of the paracone, the metacone and the posterior root are preserved. A large wear surface exists in the lingual face covering the most part of the crown height. The metacone is long and sharp. The posterior root is very large.

The p4 has a narrow and elongated elliptical outline. The crown is high, and its three cuspids are centrally lined and have sharp crests. The a.a.c. is the smaller and the lowest cuspid, and it is inclined forward. The central cuspid is as long as the half of the total length. The p.a.c. is larger than the a.a.c. The cingulum surrounds the distal and lingual margins of the tooth, and it is thick in the lingual side of the p.a.c. The posterior root is thicker than the anterior one.

These specimens cannot be attributed to *Megantereon* CROIZET & JOBERT 1828 because of their larger size, higher crown of premolars and the larger metacone of P4. The measurements given above fit with that of *Homotherium crenatidens* (FABRINI 1890) which is a common species of late Pliocene and early Pleistocene mammal faunas of Europe. As regards to the morphology, P4 and p4 from Sarikol Tepe do not present any difference with the specimens from Tuscany (FICCARELLI 1979) and Senèze, Perrier and Sainzelles (France; BOULE 1901, BALLESIO 1963, BONIS 1976). However, the Sarikol Tepe P3 is quite larger and higher crowned compared to most specimens described by these authors. As stated by FICCARELLI (1979: 24) "variations in premolar size are quite normal in so specialized forms". It is true that P3 is reduced (small size, simple crown, single root) in specimens described from Tuscany (FABRINI

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1990, FICCARELLI 1979) and from France (BOULE 1901, BALLESIO 1963, BONIS 1976). However, BOULE (1901: fig. 12) also attributed to *H. crenatidens* the material from Ceyssaguet (Haute-Loire, France) which includes a P3 which is large and has three cusps and two strong roots, almost as in the Sarikol Tepe specimen.

Some fragmentary remains from a few central European middle Pleistocene localities were described as *Homotherium moravicum* (WOLDRICH 1916) (see THENIUS 1972). It is characterized by its larger size and more elongated metacone of P4 compare to *H. crenatidens*, and also to the Sarikol Tepe material. Moreover, some scanty remains from several Asiatic and African localities were described as new species or attributed to one of the European species. As observed by FICCARELLI (1979), the fragmentary state of these findings make obscure their systematic status. In summary, the Sarikol Tepe specimens fit in size and morphology with *H. crenatidens*; however, their fragmentary state and the lack of characteristic dental and cranial elements do not allow their certain attribution to this species.
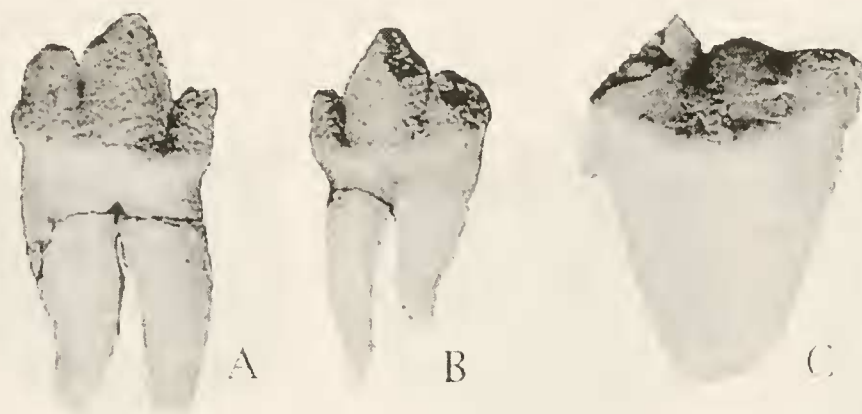

Fig. 13: *Homotherium* sp. from Sarikol Tepe, Turkey. A: p4 dex, SGT-82, labial view; b: P3 sin, SGT-80, lingual view; C: fragment of P4 dex, SGT-81, labial view, Natural Size.

Family Equidae GRAY 1821

Genus Equus LINNAEUS 1758

Equus stenonis COCCHI 1867
(Fig. 14, Tabs. 1, 2)

Synonyms: 1965. *Equus stenonis* , OZANSOY, pp. 56-57, pl. VI, figs. 6, 7.
1991. *Equus stenonis* , SEN, p. 251.

M a t e r i a l : dP2 sin, SGT-2; dP3 sin, SGT-7; P2, SGT-1, 71; P3/4, SGT-4, 5, 72a; M1/2, SGT-6, 72b; M3, SGT-3; i1-i2, SGT-10, 15; p3/4, SGT-9; lateral metapodials, SGT-27, 28, 29, 30, 31, 34; McIII, SGT-26 (partly destroyed), 70; distal epiphysis of McIII, SGT-24, 25; astragali, SGT-16, 17, 18, 19, 20; calcaneum, SGT-21 (partly destroyed; Height max=aprx 120); first phalanx, SGT-32 (partly destroyed; Height max=aprx100; DTdiaphysis=36; DAPdiaphysis=25.7); part of 3rd phalanx, SGT-33.

Description:
The material corresponds to one young and four mature individuals at least. However, the dental material mainly represents three individuals of different ontogenetic age. OZANSOY (1965: pl. VI, figs. 6, 7) illustrates the specimens SGT-72 a & b as M1-M2 from the same individual and SGT-71 as P3(?). In fact, the specimens SGT-72a and b are a P4 and a M1 of

different individuals, while SGT-71 is evidently a P2. Although the material is badly preserved with several partly destroyed specimens, it allows its specific determination (Fig. 14).

The parastyle and mesostyle of upper cheek teeth are well developed and simple (not grooved). The fossettes are isolated and closed. The enamel plication is weak: at mean 6 plis for premolars (n=3) and 5 for molars (n=4). The premolar protocone is short with flat lingual border. It is rounded in P2, more elliptical in P3/4. The molars, and especially M3, have more elongated protocones, slightly grooved lingually. The pli-caballin is small and simple. The hypocone is short with rounded distolingual wall. There is no hypoconal islet. The lingual groove is weakly developed in premolars; it is missing from the molars. The teeth are quite hypsodont; the hypsodonty index (H of parastyle x 100 / occlusal length) is 244 in M3 (first stage of wear) and 195 in P3/4 (moderately worn). The single preserved lower premolar is broken mesio-lingually and very worn. The lingualflexid seems to be V-shaped and shallow.
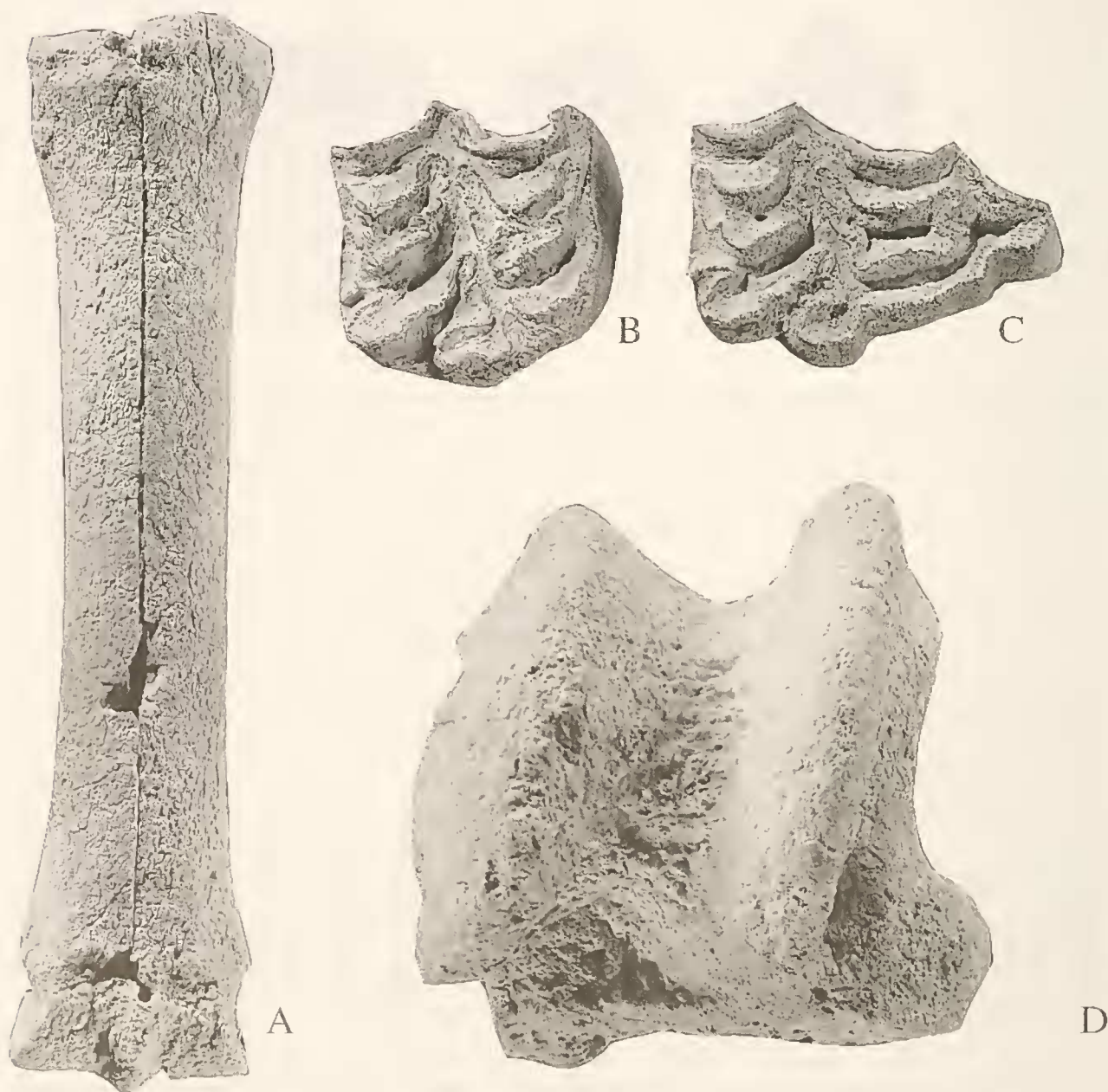

Fig. 14: *Equus stenonis* from Sarikol Tepe, Turkey. A: Mc III, SGT-70, anterior view; B: P3/4, SGT-72a, occlusal view; C: P2, SGT-71, occlusal view; D: astragalus, SGT-18, anterior view. Scale: A=1/2 nat. size; B-D= natural size.

Table 1: Dental measurements of *Equus stenonis* from Sarikol Tepe, Turkey.

	P2 (n=2)	P3/4 (n=2)	M1/2 (n=2)	M3 (n=1)
Locclusal	43.45-43.81	31.02-35.05	28.28	28.3
L 1cm above base	41.45-42.47	27.99-32.11	26.51	31.77
W occlusal	28.50-28.76	30.31-31.02	29.19	24.64
Lprotocon	7.27-8.06	8.16-9.78	10.01	12.52
Wprotocon	5.57-6.41	4.84-5.88	5.09	4.33
Plication number	5-6	6	4	5
Height of parastyle	-	68.35	-	68.97

Table 2: Postcranial measurements of *Equus stenonis* from Sarikol Tepe, Turkey (according to the system proposed by EISENMANN et al. 1988).

	McIII SGT-70	McIII SGT-26	McIII SGT-25	McIII SGT-24	Astragalus n=5
1	250.1	-	-	-	67.0-69.9
2	240.0	-	-	-	68.9-75.0
3	39.06	38.7	-	-	32.9-33.4
4	29.19	27.8	-	-	70.6-74.8
5	57.54	63.3	-	-	55.6-56.5
6	35.0	35.2	-	-	35.7-38.5
7	41.2	43.2	-	-	57.8-58.6
8	15.8	14.5	-	-	
9	-	-	-	-	
10	54.31	-	52.8	53.2	
11	57.24	aprx 55	54.0	-	
12	37.26	-	36.8	38.9	
13	29.5	-	28.7	29.8	
14	31.0	-	31.6	-	

There is no evidence for a pli caballinid. The posterior cusp of the double-boucle (entoconid) is square-shaped (Tab. 1, 2).

The third metacarpal is elongated and robust; its proximal and distal epiphyses are well extended transversally. The slenderness index (DTdistal x 100 / length) is 22.9 while the robustness index (DT diaphysis x 100 / length) is 15.6. The 2nd metacarpal is fused with the third one, while the 4rth rests independent. The posterior face of the keel is quite high. The supraarticular fossa of the distal epiphysis is not very sharp in anterior view. The supraarticular breadth of the distal epiphysis is equal or even smaller than the articular one. The crest distinguishing the facets for the cuboid and the navicular in the preserved astragali, is well developed. The facet for the cuboid is slightly oblique. The attachement of the appendix with the main articular surface for the calcaneum has parallel borders. The index "height of lateral condyle x 100 / maximal breadth" varies between 93 and 100.3 (mean = 97.7). The sustentaculum

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tali of the calcaneum is partly destroyed. The coronoid apophysis forms a more or less vertical angle. The proccessus lateralis is weakly inclined on the median axis. Although partly distroyed the single preserved first phalanx shows a relatively short V-scar ("index L V-scar x 100/ Lmax" approximately 60).

Comparison:

OZANSOY (1965) briefly described a part of the referred material and pointed out the great similarities between the "Yassiören" horse and *Equus stenonis*. A more detailed comparison will be given here.

The general morphological and proportional characters of the studied equid, clearly approach it to the Plio-Pleistocene "stenonoid" forms from Europe and their allies in Asia (*Equus livenzovensis, E. sanmeniensis, E. namadicus*), distinguishing it from the fossil "caballoid" forms. Based only on the poor dental and postcranial material from Sarikol Tepe, a clear distinction from the several representatives of the "stenonoid" group seems to be premature.

Nevertheless, the studied equid differs from *E. livenzovensis* BAIGUSHEVA 1978 – as this form has been recently redefined by FORSTEN (1998) – by its smaller size and greater robustness (Fig. 15), its shorter protocone, the weaker plication of the pre- and postfossettes, the absence of grooves in para- and mesostyles and may be by the shallower post-protoconal groove. *E. namadicus* FALCONER & CAUTLEY 1849 and *E. sanmeniensis* TEILHARD & PIVETEAU 1930 present longer protocones (Fig. 16) than the studied form. *E. sanmeniensis* is additionally larger in size

Fig. 15: Logarithmic ratio-diagram, comparing the metacarpal dimensions of *Equus stenonis* from Sarikol Tepe, Turkey, with several Plio-Pleistocene equids. Standard= *E. hemionus onager*, mean values, EISENMANN 1979.

■ *Equus stenonis* from Sarikol Tepe, Turkey
◆ *E. s. stenonis* from Olivola, Italy (pers. meas.)
▲ *E. s. vireti* from St. Vallier, France (data from EISENMANN 1979)
◇ *Equus s.* cf. *vireti* from La Puebla, Spain (data from EISENMANN 1979)
❏ *Equus livenzovensis* from Liventsovka, W. Russia (data from FORSTEN 1998)

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(Fig. 15) with longer P2 comparatively to P3; the index "Locclusal P2 x 100/ Locclusal P3" is 132 in the specimen NIH 004 (Eisenmann 1980) of *E. sanmeniensis* versus 125 in the Sarikol Tepe form (Fig. 15, 16).

The morphological and metrical characters of the Sarikol Tepe equid, such as the short protocone (Fig. 16), the slightly plicated enamel (5 plis at mean), the rounded hypocone, the V-shaped linguaflexid, the general proportions and dimensions of the metacarpal (Fig. 15), the well developed crest, distinguishing the facets for the cuboid and navicular and the oblique cuboid facet in the astragali, the weakly inclined lateral procces of the calcaneum and the relatively short V-scar of the first phalanx, are very similar to those of *Equus stenonis* (De Giuli 1972, Eisenman 1979, 1980, Azzaroli 1982).

The high protocone index of the Sarikol Tepe M3 (=44) is probably due to the quite unworn teeth; the same index estimated 2 cm above the base of the crown is 36, clearly in the variation of *E. stenonis*. In the specimen SGT-70 (McIII) the second metacarpal is fused with the third one, while the keel appears to be high in the posterior face. Both characters partly differentiate the studied form from the typical *E. stenonis*, but their systematic value and variation are unknown. *Equus stenonis* presents a vast chronological and geographic expansion; it is known from the middle-late Villafranchian faunas of southern Europe (Spain, France, Italy, Greece) but also from Kazakhstan, Siberia and China (Azzaroli 1990). (Fig. 17, 18)

m=*E. mosbachensis*
n=*E. sanmeniensis* Nihowan
s= *E. stenosis* St.-Vallier
p= *E. stenonis* La Puebla
v= *E. stenonis* Volakas
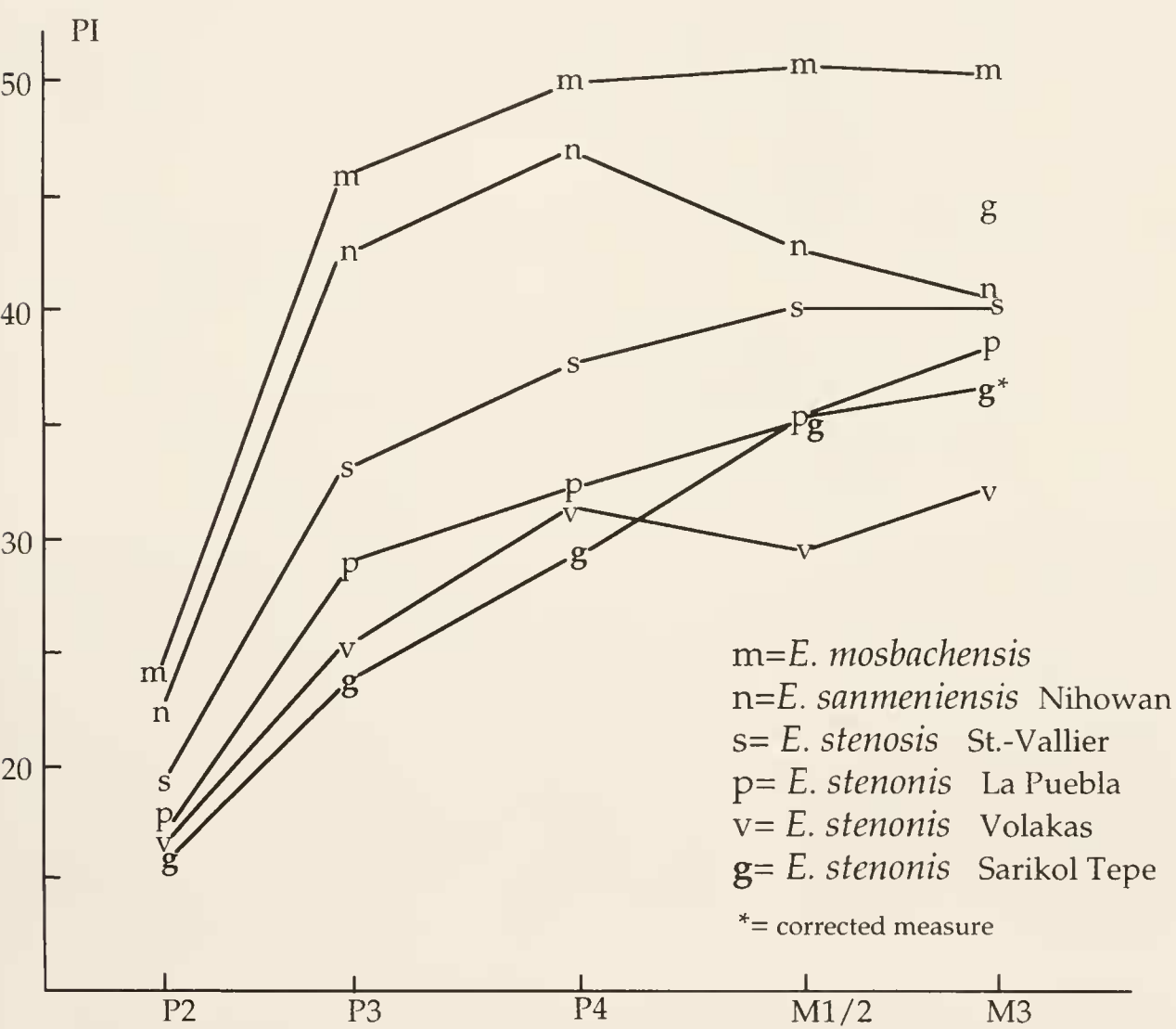g= *E. stenonis* Sarikol Tepe

*= corrected measure

Fig. 16: Development of protocone index (data from Eisenmann 1980; Koufos & Vlachou 1997).
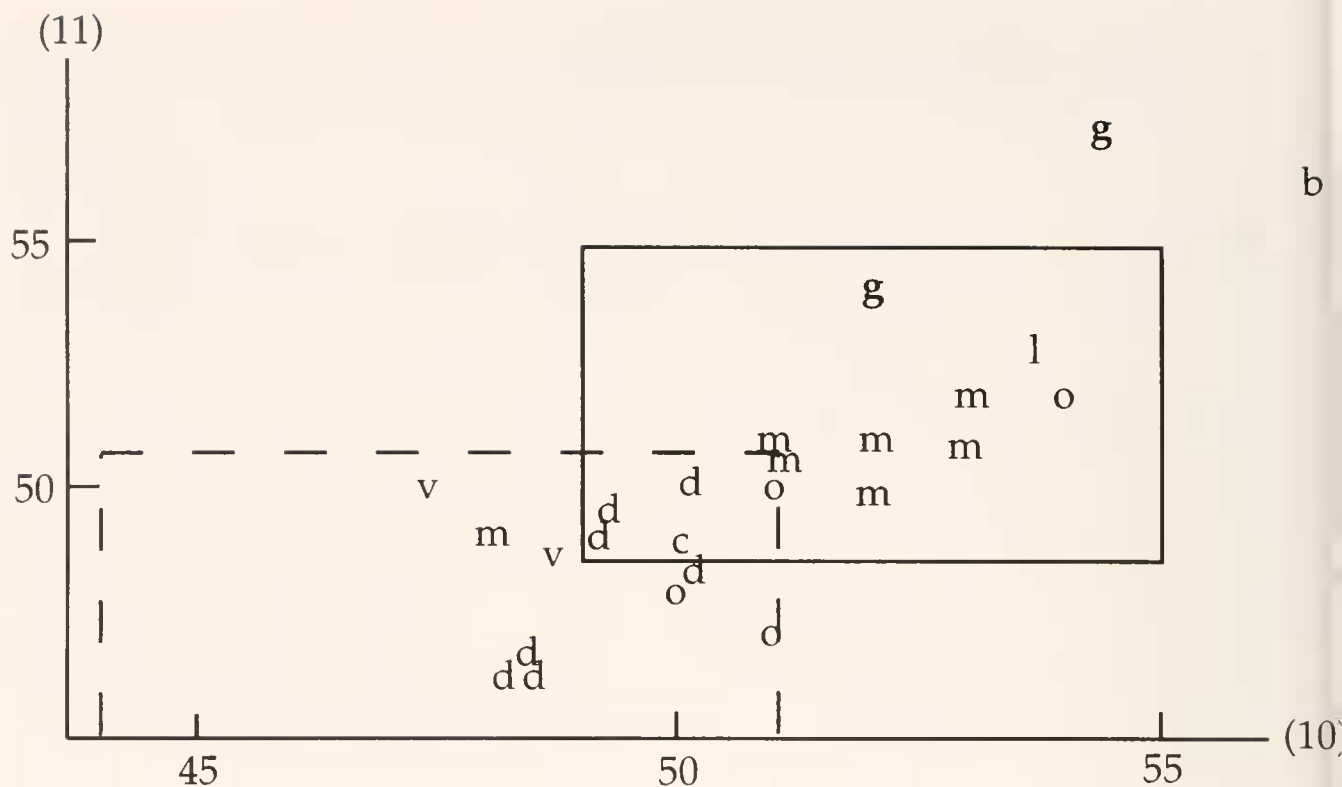
Fig. 17: Scatter diagram comparing the metacarpal proportions of several Plio-Pleistocene equids. (11)= DTdistal post-articular, (10)= DT distal articular (data from DE GUILI 1972; EISENMANN 1979; BOEUF 1986; KOUFOS & KOSTOPOULOS 1993; KOUFOS & VLACHOU 1997; FORSTEN 1998).

g = *Equus stenonis* from Sarikol Tepe, Turkey
o = *E. s. stenonis* from Olivola, Italy
m = *E.s. stenonis* from Matassino, Italy
d = *E. s. cf. vireti* from Dafnero, Greece
v = *E. s. cf. vireti* from Volakas, Greece
c = *E. s. guthi* from Chillac, France
l = *E. livenzovensis* from Liventsovka, Ukraine
b = *Equus mosbachensis* from Mosbach, Germany
- - - *E. s. cf. vireti* from La Puebla, Spain
___ *E. s. vireti* from St. Vallier, France

Because of the insufficient material, it is hard to proof certain relationships between the Sarikol Tepe horse and some of the referred subspecies of *E. stenonis*. According to the postcranial dimensions and proportions (Fig. 15) it seems to be closer to the robust *E. stenonis vireti* from St. Vallier (France) and to *E. stenonis stenonis* from Olivola (Italy). The extremely high value of DT distal (SGT-70), exceeding the maximum values of all the forms in comparison, cannot be accepted as significant because of the bad preservation of this part of the specimen; in the specimen SGT-26 this measure is 55mm, which seems to be more reliable. Figs. 17 and 18 show that the Sarikol Tepe equid is placed in close proximity to the largest individuals of *E. stenonis vireti* from St.-Vallier, being significantly larger than *E. stenonis* cf. *vireti* from Spain and Greece, as well as *E. s. guthi* from Chillac.
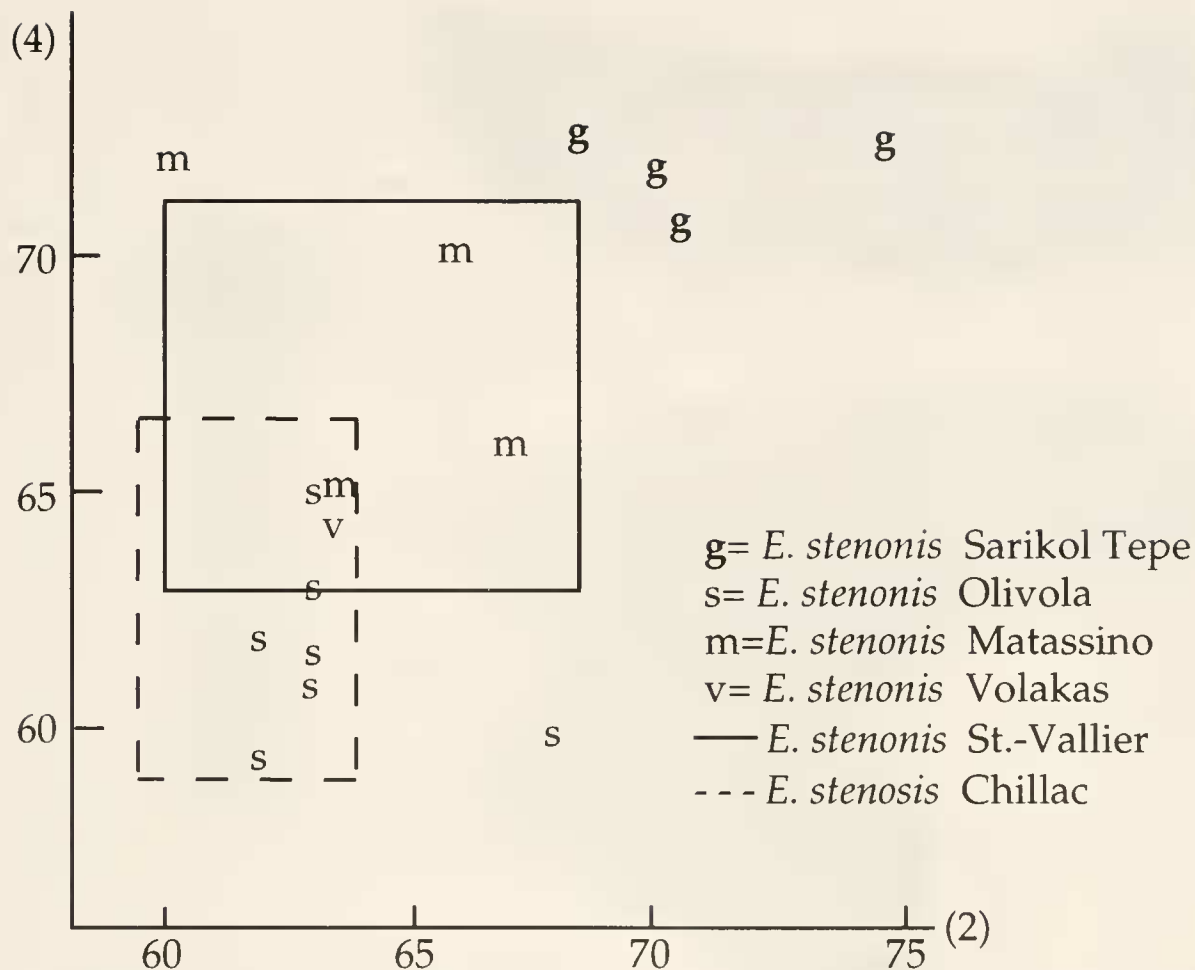
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Fig. 18: Scatter diagram comparing the astragalus proportions of several Plio-Pleistocene equids. (4)=breadth of trochlea; (2)=maximal diameter of median trochlea (data from DE GUILI 1972; BOEUF 1986; KOUFOS & VLACHOU 1997).

In the diagram:

g= *E. stenonis* Sarikol Tepe
s= *E. stenonis* Olivola
m=*E. stenonis* Matassino
v= *E. stenonis* Volakas
—— *E. stenonis* St.-Vallier
- - - *E. stenosis* Chillac

Family Camelidae GRAY 1821

Genus *Paracamelus* SCHLOSSER 1903

Paracamelus cf. *alutensis* (STEFANESCU 1895)
(Fig. 19)

Synonym: 1991. Camelidae indet., SEN, p. 215.

M a t e r i a l : Part of maxilla SGT-35, with P4-M3 dex (P4: L=24.5, W=20.4; M1: L=24.7, Want=-, Wpost=23.2, M2: L=31.4, Want=24.9, Wpost=22.1; M3: L=31.9, Want=22.7, Wpost=18.3) and P3-M1 sin (P3: L=19.7, W=13.2; P4: L=22.2, W=19.4; M1: L=-, Want=-, Wpost=22.5); M3 sin in situ, SGT-41 (L=32, Want=20.2, Wpost=15.6); i2, SGT-50 (W=8.32); i3, SGT-51 (L=18.4, W=11.5); part of mandibular ramus with the alveoli of premolars and m1, SGT-43 (L=26.5, Want=16.7, Wpost=17.4); m1/2 isolated, SGT-44; part of the distal epiphysis of metacarpal III+IV, SGT-23; proximal epiphysis of metatarsal III+IV, SGT-55 (DTproximal=53.13, DAPproximal=47.38, DTdiaphysis=34.0, DAPdiaphysis=37.5); fragment of proximal epiphysis of metatarsal, SGT-56.

Description:

P2 is absent. The length of the upper toothrow P3-M3 is about 129mm (length M1-M3dex = 87.20; length P3-P4 sin=41.6mm). P3 has a very simple morphology with strong parastyle,
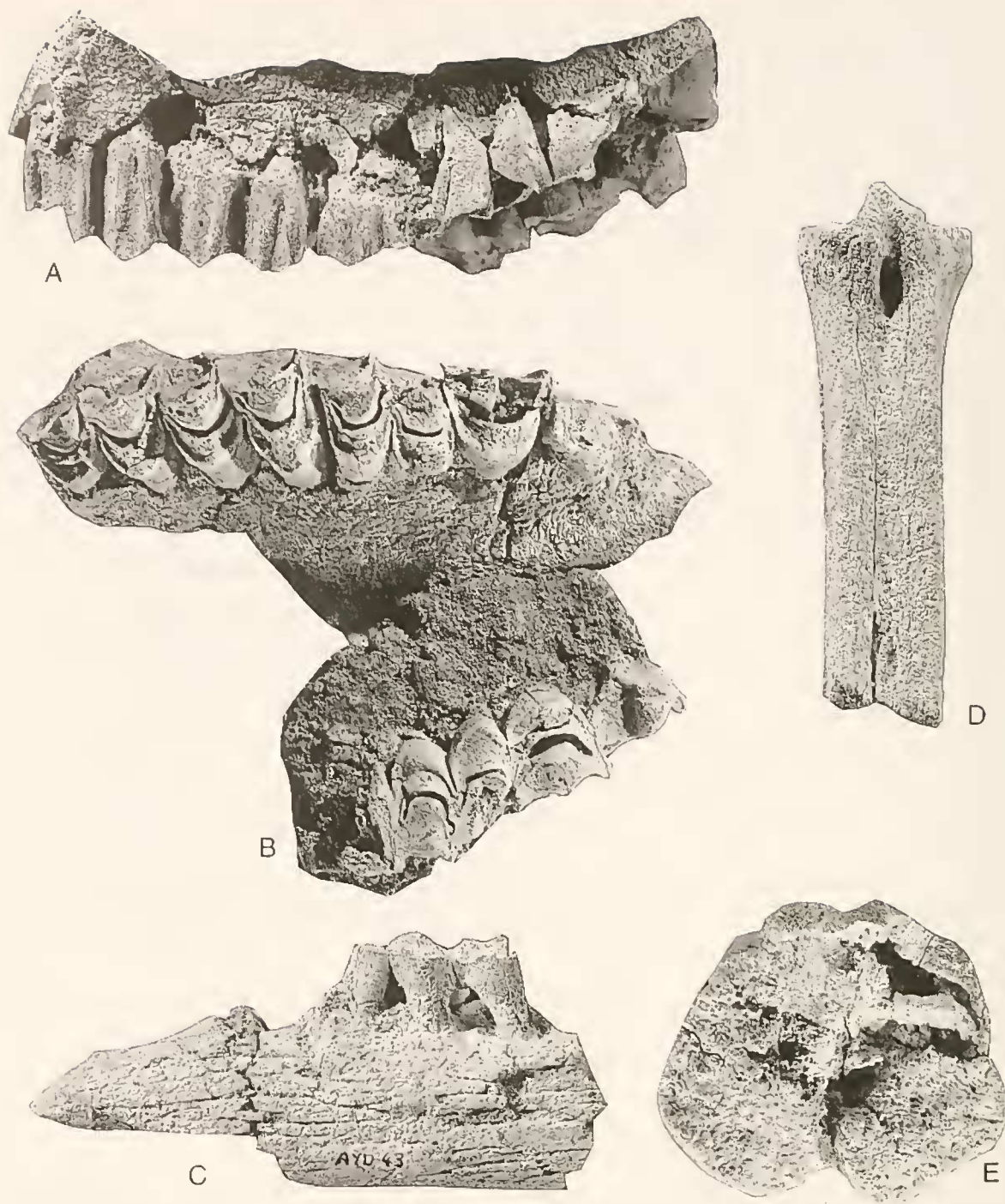
Fig. 19: *Paracamelus* cf. *alutensis* from Sarikol Tepe, Turkey. A: maxilla SGT-35, labial view; B: *idem*, lingual view; C: part of mandibular ramus, SGT-43, labial view; D: Proximal part of MtIII+IV, SGT-55 posterior view; E: *idem*, proximal view. Scale: A-C=3/5 nat. size; D=2/5 nat. size; E= 4/5 natural size.

weak metastyle and well curved rib of paracone. The lingual face is semicircular shaped without trace of a hypocone. P4 is slightly longer and significantly wider than P3. It is sub-square shaped with strong parastyle, weak metastyle and strong rib of paracone. The protocone is well developed, while in the distolingual angle of the tooth, a rudimentary hypocone is present. The upper molars have strong styles and ribs. The parastyle is connected with the paracone at the base of the crown. The metacone is less developed than the paracone. The metastyle of M3 is strong; there is no evidence for accessory styles or central islets.

The horizontal ramus is very low; its height between p4-m1 is 40 mm. In the lower toothrow, both p3 and p4 should be present; in the preserved specimen appears only the posterior lobe

of p4 but the presence of a well developed p3 is confirmed by its alveoli. The length p3-p4 is estimated about 35-40 mm. The morphology of the lower molars is poorly known; the two lobes of the isolated m1, SGT-44, present a relative displacement between them. The metastylid is well developed; a weak cingulum appears mesio-lingually.

The lower part of the metacarpal III+IV is broken just above the distal trochleae. The transverse diameter at the point where the metacarpals are diverging is 48 mm. The proximal epiphysis of the metatarsal III+IV is more or less symmetrical and pentagon-shaped. In the posterior face of the distal projection a well elongated deep groove is present. The forth metacarpal appears more developed anteroposteriorly than the third one in the proximal part of the diaphysis. (Fig. 19)

Comparison:

As regards the taxonomic literature of the Old World camels, two genera appear: *Paracamelus* SCHLOSSER 1903 and *Camelus* LINNAEUS 1758. The familly seems to be originated from the N. American genera *Procamelus* or *Megacamelus* (HARRISON 1985; PICKFORD et al. 1995). *Procamelus khersonensis* PAVLOW 1903 from Kherson is later tranferred to *Paracamelus* (KHAVESSON 1954). The appearance of the family in the Old World has been traditionally regarded as middle-late Pliocene (Villafranchian). Nevertheless, recent data from Spain and Turkey proved an earlier immigration at the end of Miocene (MN13) (PICKFORD et al. 1995; MADE et al. in press). The genus *Paracamelus*, erected by SCHLOSSER (1903), includes several Eurasian species, dated from the late Miocene to the early – middle? Pleistocene; the middle-late Pleistocene and living forms of the Old World camels are referred to the genus *Camelus*. Nevertheless, HARRISON (1985) consider *Paracamelus* as a subgenus of *Camelus*.

Although the remarkably numerous references to the genus *Paracamelus*, its systematics and biochronology are still obscure, because of

1. the usually scarce fossil record, including few specimens which in many cases are not comparable between them, and

2. the unknown (or at least insufficiently) stratigraphic origin of the specimens.

The revision of *Paracamelus* by KHAVESSON (1954) partly eliminate the above mentioned problems. This author divides the genus in two subgenera *Paracamelus* and *Neoparacamelus*, accepting five valid species:

- *P. (Paracamelus) gigas* SCHLOSSER 1903: type species, well defined later by ZDANSKY (1926).
- *P. (Paracamelus) alexejevi* KHAVESSON 1950: well defined by KHAVESSON (1954).
- *P. (Paracamelus) praebactrianus* (ORLOV 1927): based only on a hind leg, this species seems questionable.
- *P. (Neoparacamelus) alutensis* (STEFANESCU 1895): species originally known from two mandibular rami.
- *P. (Neoparacamelus) kuljenensis* (KHOMENKO 1915): based on a poor sample.

In this list should be also included the species *Paracamelus aguirrei* MORALES 1984 from the late Miocene of Spain and Turkey.

The subgenus *Neoparacamelus* is defined by KHAVESSON (1954, 1968) as "a dwarf subgeneric group – (Pliocene to lower Pleistocene) – of the Black Sea area which usually lacks the anteroexternal folds on m2 and m3". TOPACHEVSKI (1956, in BAIGHUSEVA 1971) considers *P. kuljanensis* as a synonym of *P. alutensis*. In fact, both are known from their mandibular and lower teeth morphology, which seems to be very similar (e.g. KHAVESSON 1954: Tabs. 2, 3). KHAVESSON (1954) refers *Procamelus khersonensis* PAVLOW 1903 and *Camelus bessarabiensis* KHOMENKO 1912 to *Paracamelus* sp. The material of these two species seems insufficient for certain determination. The camel from Lac Ichkeul (Tunisia) attributed by ARAMBOURG (1979) to *C. thomasi* POMEL 1893, as well as *C. bessarabiensis* from Maluşteni (SIMIONESCU 1930) are
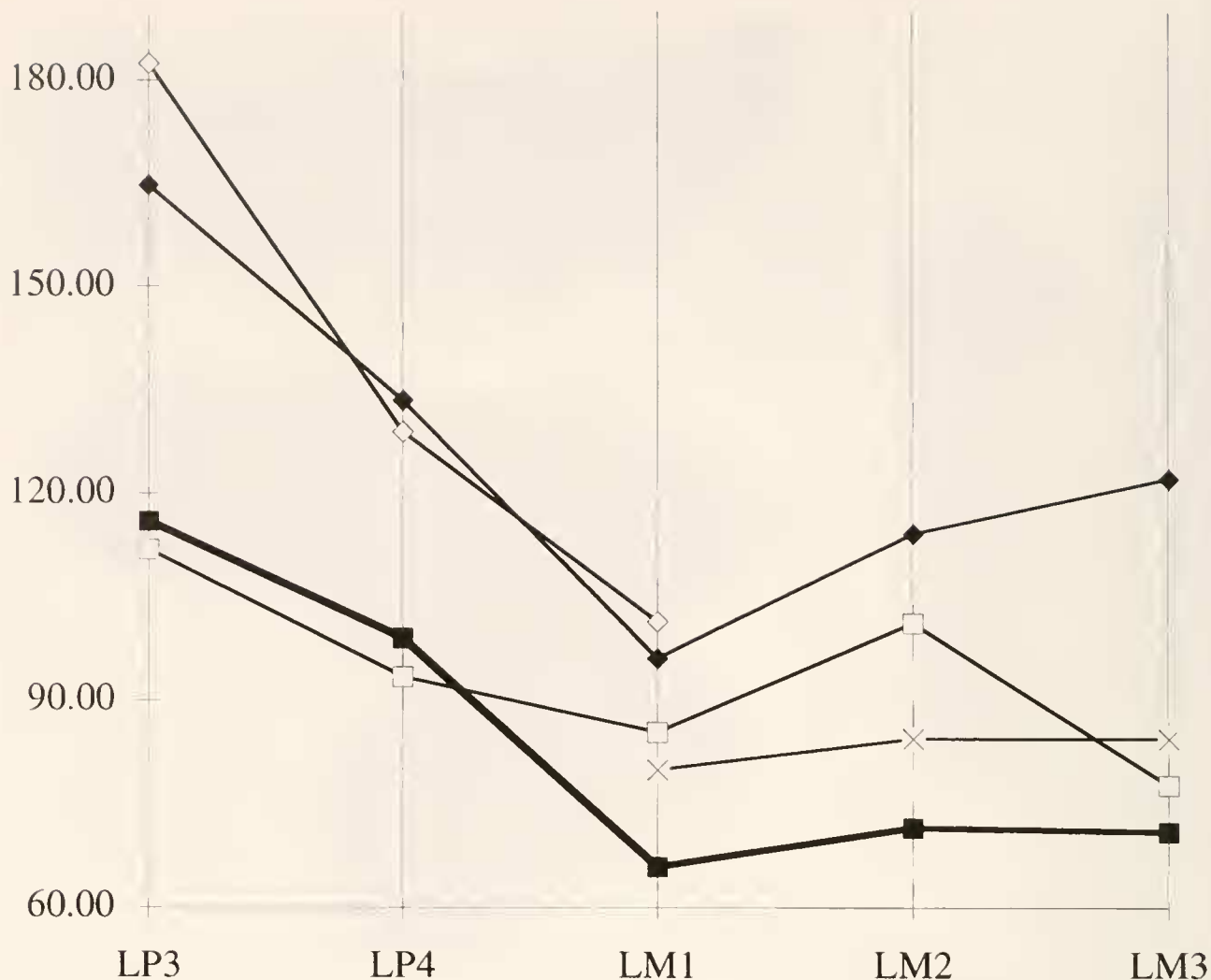
Fig. 20: Percentage ratio diagram comparing the teeth dimensions of several Plio-Pleistocene camelids. Standard= *Camelus bactrianus* (data from LESBRE 1900).

■ *Paracamelus* cf. *alutensis* from Sarikol Tepe, Turkey
◆ *P. gigas* (data from ZDANSKY 1926)
◇ *P. gigas* from Nihowan, China (data from TEILHARD & TRASSAERT 1937)
❑ *P. alexejevi* (data from KHAVESON 1954)
✖ *Camelus dromedarius* (data from LESBRE 1900)

also referred to *Paracamelus* sp. (PICKFORD et al. 1995 and KHAVESSON 1954, respectively). *Camelus knoblochi* BRANDT (in NEHRING 1901) and *C. ferus* PREWALSKI 1883, are considered to be of subspecific value, referred to the species *C. bactrianus* (KHAVESSON 1968). The camels from the faunal complex of Siwaliks (Pakistan-India) are also problematic; according to MATTHEW (1929) *C. sivalensis* FALCONER & CAUTLEY 1836 presents clear similarities with the extant species *C. bactrianus*.

Fig. 21: Percentage ratio diagram comparing the metatarsal dimensions of several Plio-Pleistocene camelids. Standard and symbols as in Fig. 18 and:
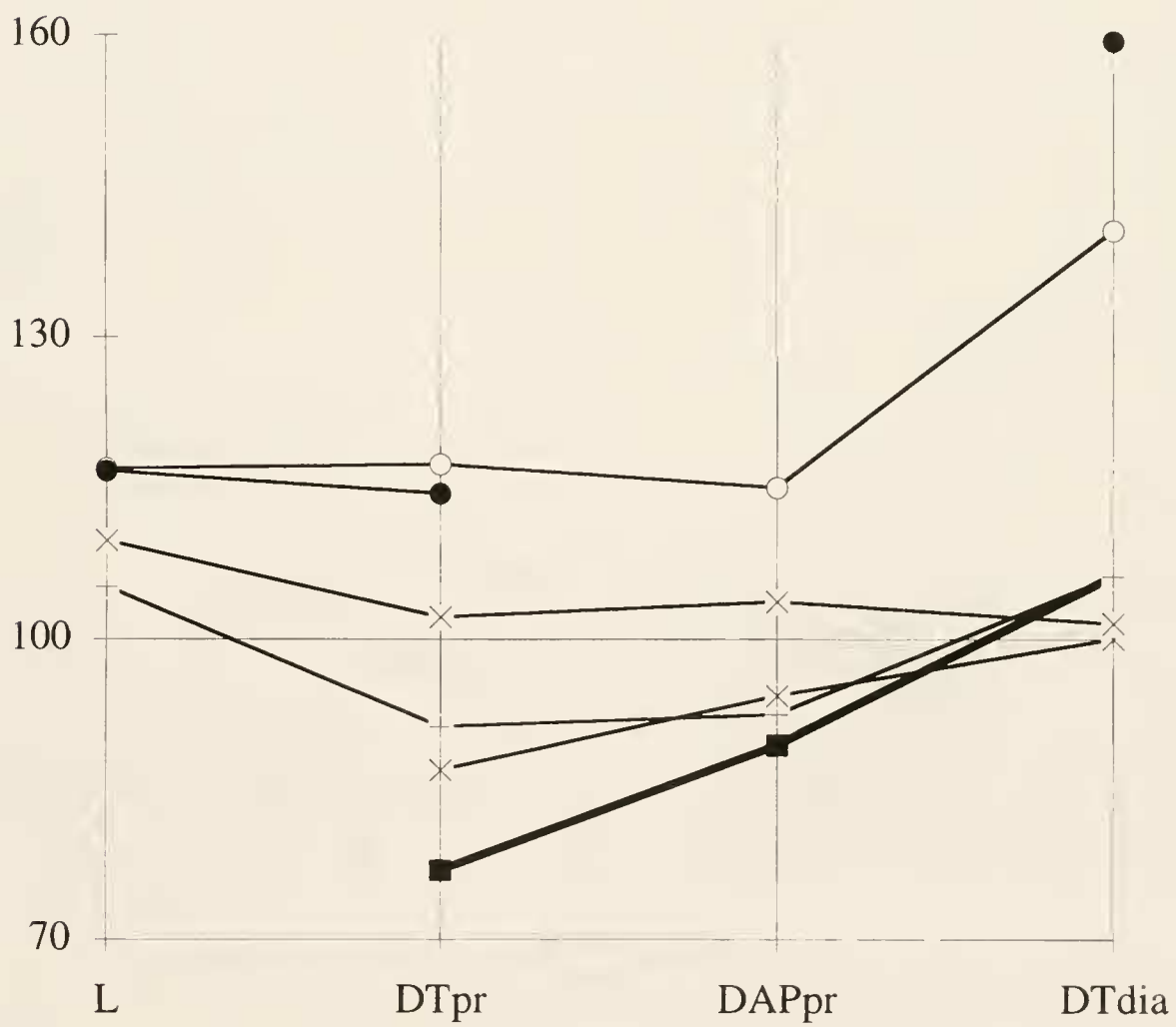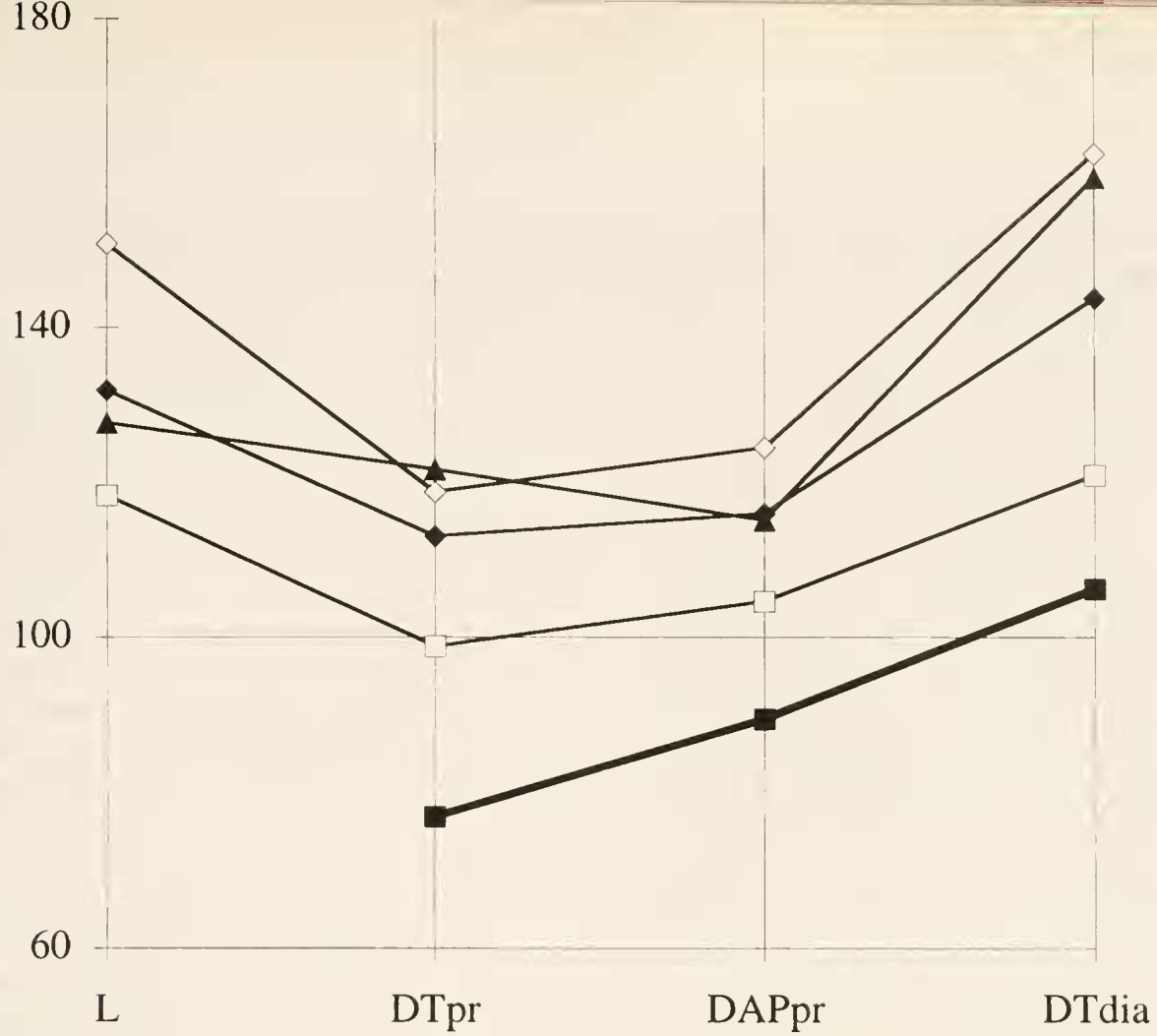◗ *Camelus bactrianus knoblochi*, type (data from BOULE et al. 1928)
● *C. b. knoblochi* from Ordos, China (data from BOULE et al. 1928)
✚ *C. b. ferus* (data from KHAVESON 1954)
✳ *Paracamelus praebactrianus* (data from KHAVESON 1954)
▲ *P. gigas* from Choukoutien (data from YOUNG 1932)

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The definition of the genus *Paracamelus* was for a long time open. TEILHARD & TRASSAERT (1937), studying *P. gigas* from Nihowan and Shansi summarized some generic (?) characters and concluded that "... the validity of the species and of the genus are fully confirmed, so far as these are based on the large development of the third premolar and some definitive characters of the metapodials (shape of the proximal facets of metacarpal, deep groove of the proximal process of metatarsal etc.). But on the other hand the presence of caniniform first premolar (regarded as absent by ZDANSKY 1926) is unquestionably proved". Finally KHAVESSON (1954, 1968) gave a relatively complete diagnosis of both *Paracamelus* and *Camelus* (Fig. 20, 21).

The reduced length of P4, the reduced or even absent P3, the strong presence of cement, the less developed pillars of upper molars and their significantly wider dimensions, the weak metastyle of M3 and of course the absence of p3 clearly distinguish the recent camels from the studied one (LESBRE 1900 and pers. obs.). Moreover, both living species (*C. bactrianus* and *C. dromedarius*) are clearly larger than the Sarikol Tepe form (Fig. 20). The late Pleistocene *C. bactrianus knoblochi* differs by its larger size (Figs. 20, 21a), the reduced upper premolar row; compared to the molars, and the strong anteroposterior development of the metatarsal's proximal part of diaphysis (NEHRING 1901; BOULE et al. 1928). The presence of a well developed P3, the eventual presence of a p3 (SGT-43), the strong styles and pillars on the upper molars and the absence of cement, as well as the morphology of the metatarsal, approach the Sarikol Tepe form to the genus *Paracamelus* (ZDANSKY 1926; TEILHARD & TRASSAERT 1937; KHAVESSON 1954).

In comparison to the known species of *Paracamelus*, the Sarikol Tepe camel is significantly smaller than *P. gigas* and even smaller than *P. alexejevi* (Fig. 20, 21b). The morphology of the studied upper toothrow is very similar to that of *P. gigas* and *P. alexejevi*, but both species present a shorter upper premolar row comparatively to the molars. As far we know about *P. praebactrianus*, it seems to be of a similar size with the studied form (similar dimensions of the metatarsal, Fig. 21b) but the validity of this species is questionable.

The dimensions of the Sarikol Tepe camel fit also well with those of *P. alutensis*. Unfortunately the species is only known by its mandible and therefore a detailed comparison is impossible. Nevertheless, the length p3–p4 of *P. alutensis* is 33–35 mm (data from KHAVESSON 1954), i.e. very close to the studied one. The length of m1 is 27 mm in the worn specimen SGT-43 versus 31 mm in *P. alutensis*. Moreover both *P. alutensis* and Sarikol Tepe camel present a very low horizontal ramus. The p4 of *P. alutensis* has a well developed hypoconid, as at Sarikol Tepe, while *P. alexejevi* lacks this feature.

According to the available data, the Sarikol Tepe camel corresponds to a small representative of *Paracamelus*. A restricted number of morphological features approach it to the insufficiently known *P. alutensis*. This species was firstly described from the early Pleistocene deposits of Oltet Valley in Romania (STEFANESCU 1910); camel remains from the early-middle (?) Pliocene locality of Liventsovka in Russia were also referred to this species (BAIGUSHEVA 1971). The middle Pliocene *P. kuljenensis* from Russia is probably a younger synonym. The small "*C. antiquus*" from Siwaliks (characterized by a shallow mandible, smooth enamel, small goat fold and displacement of the inner wall on the molars) probably belongs to the same group of small camelids, to which may be included the Camelidae gen. indet. from Choukoutien (YOUNG 1932). Thus, the chronological extension of *P. alutensis* covers the entire Villafranchian. According to KHAVESSON (1954, 1968) this group of "dwarf" camelids is originated from the *P. alexejevi-P. gigas* lineage, from which it was separated at the end of early Pliocene.

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cf. *Pliotragus* KRETZOI 1941
(Figs. 22, 23F, Tab. 3)

M a t e r i a l : M3, SGT-42 (L= aprx 30, Want=19); p3 dex, SGT-47 (L=16.2, W=10.9); p4 dex, SGT-48 (L=19.1, W=12.2); distal part of tibia, SGT-11,13,14 (DTdistal= 45-51, DAP distal=35-38)

Description and comparison:

The posterior lobe of the single upper molar – probably a M3 – is broken. The para- and mesostyle are well projected labially, while the metastyle is strong, directed distally. The paracone rib is well marked and the protocone is angular lingually. The two lobes are fused from the first stage of the wear. A well developed central islet is present in occlusal view.

The specimens SGT-47 and 48 probably belong to the same individual. p3 has a well developed parastylid, separated clearly from the paraconid. The latter one is directed distally with a clear tendency to close the second valley, just above the base of the crown. The metaconid is robust, directed distally, but it rests free from the entoconid-entostylid complex. Both entoconid and entostylid are fused, forming a well developed disto-lingual stylid. A rudimentary hypoconid appears in the disto-labial angle of the tooth. A shallow, vertical furrow separates hypoconid from protoconid. The p4 is totally molarized with well developed parastylid. The continuous lingual wall presents a relatively deep furrow between the well

Table 3: Comparison between cf. *Pliotragus* from Sarikol Tepe (Turkey) and other related Plio-Pleistocene genera (data from DUVERNOIS & GUERIN 1989; KOSTOPOULOS 1998 and pers. data)

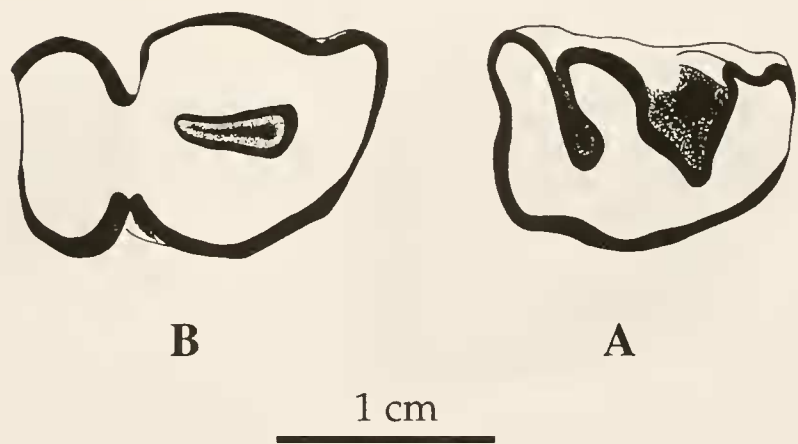|	cf. *Pliotragus* SGT	*Pliotragus*	*Gallogoral*	*Procamptoceras*
	n=1	n=5	n=10	n=2
p3 LxW	16.2 x 10.9	(14-15.5)x(12-13.5)	(14-15.2)x(8.5 x9.5)	12 x 8.5
p4 LxW	19.1 x 12.2	(16-19.5)x(10-13)	(14.5-18)x(9-10)	10.8 x 7.3
				Gazellospira
Tibia	n=3	n=1	n=6	n=2
DTistal	45-51	48	39-43.5	37-42.5
DAPdistal	35-38	32	31-36	29-32

B   **A**

1 cm

Fig. 22: cf. *Pliotragus* from Sarikol Tepe, Turkey. A: p3; B: p4.

curved rib of metaconid and the entoconid. On the labial face, the protoconid and hypoconid are equally developed and separated by a deep furrow (Fig. 22, Tab. 3).

The morphology as well as the dimensions of the teeth fit pretty well to those of *Pliotragus* (Tab. 3, Fig. 22) (DUVERNOIS & GUERIN 1989). The premolars of *Procamptoceras* and *Gazellospira* are clearly smaller (Tab. 3), while those of *Gallogoral* present several morphological differences comparatively to the studied form: the p3 of *Gallogoral* has a less developed paraconid, clearly distinguished hypoconid and a metaconid connected with the entoconid from the first stage of wear; *Gallogoral*'s p4 is less molarized with open third and fourth valleys, until an advanced stage of wear (GUERIN 1965; DUVERNOIS & GUERIN 1989; KOSTOPOULOS 1998). The available dimensions of the tibia (Tab. 3) show that *Gazellospira* is clearly smaller, while *Gallogoral* presents a narrower distal epiphysis, comparatively to the Sarikol Tepe specimens and *Pliotragus*. Since this genus is not yet well defined and the studied material is poor, we prefer to refer the studied form to cf. *Pliotragus*. (Fig. 23).

Genus *Gazellospira* PILGRIM & SCHAUB 1939

Gazellospira cf. *torticornis* (AYMARD 1854)
(Fig. 23A–C, Tab. 4)

Synonyms: 1991. cf. *Spirocerus* sp., SEN, p. 251

M a t e r i a l : left mandibular ramus with p2-m3, SGT-69 (p2: L=8.8, W=5.96; p3: L=12.46, W=7.05; p4: L=13, W=8.6; m1: L=17.8, W=10.9; m2: L=20.6, W=10.9; m3: L=28.5, W=9.9); partly destroyed astragalus, SGT-53 (Height=42.9, DTdistal=27.1)

Description and comparison:
The height of the horizontal ramus between p4–m1 is 24.7 mm with corresponding breadth of 15.5 mm. The second lower premolar has a short but well developed parastylid. The entoconid is separated from the entostylid in the first stage of wear. The metaconid is convex lingually. A rudimentary hypoconid is present. The parastylid of p3 is well separated from the paraconid, which is stronger and vertical to the anteroposterior axis of the tooth. The elongated metaconid is flat lingually, directed backwards and, in the present stage of wear it covers the entoconid. The latter one is more or less square in occlusal view and vertical to the anteroposterior axis of the tooth. It is distinguished from the less developed entostylid through a relatively deep furrow, which rests visible until the base of the crown. The third valley is closed, forming a fossette. A rudimentary, angular hypoconid is present. Both the paraconid and the parastylid of p4 are well developed and largely separated from one another. The paraconid presents a flat linguall wall, directed backwards, with a clear tendency to be fused with the metaconid; nevertheless, the second valley rests open until the middle of the crown's height. The metaconid is elliptical with flat lingual face and is directed mesially. A rudimentary, low, accessory stylid appears between the paraconid and metaconid. The entoconid is well developed, although fused with the metaconid, forming a continuous lingual wall between them. The third valley is shallow and furrow-like. The entostylid is less developed than the entoconid and both are
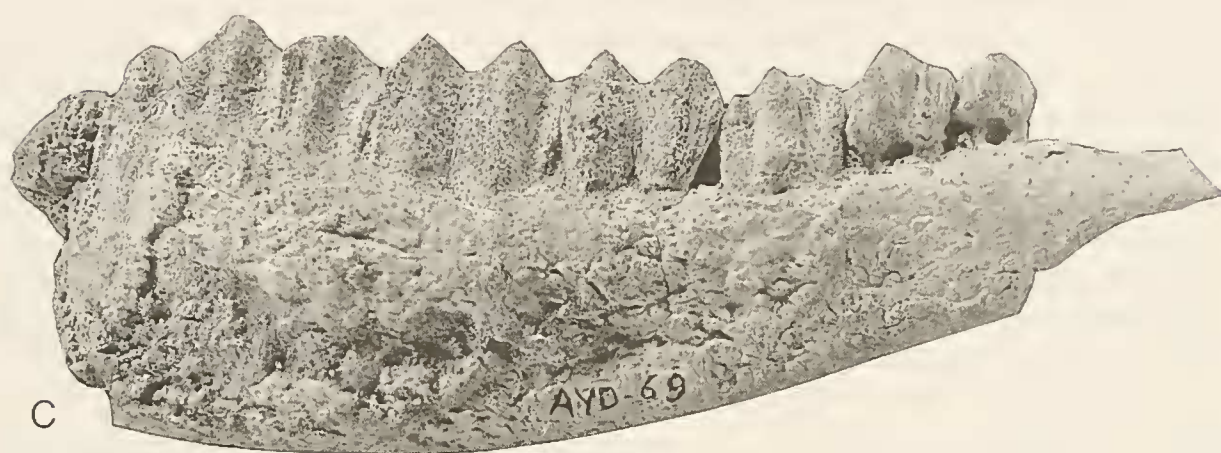
Fig. 23: A-C: *Gazellospira* cf. *torticornis* from Sarikol Tepe, Turkey; mandible, SGT-69, A: occlusal, B: labial and C: lingual view.
D-E: *Gazella* sp. from Sarikol Tepe, Turkey; D: part of M1II-IV, SGT-54; E: m3, SGT-46, lingual view.
F: cf. *Pliotragus* from Sarikol Tepe, Turkey; distal part of tibia, SGT-11, distal view.
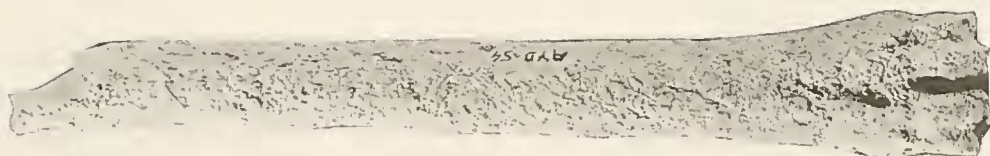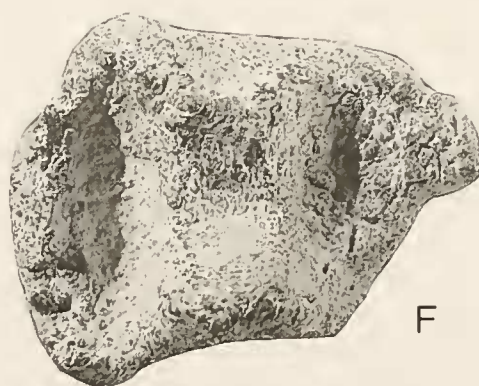Scale: A-C, E-F 4/5 natural size; D= 3/5 natural. size.

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rapidly fused, forming a closed fossette. The hypoconid is angular, well developed and separated from the protoconid by a deep labial furrow. The molars have a weak parastylid and a well marked rib of metaconid and entoconid. The metastylid is visible only in the upper part of the m3's crown. All the molars bear a strong goat fold. The third lobe of m3 is formed by a single tubercle, which is marked distally by a weak stylid.

This medium sized antelope presents clear affinities to the Plio-Pleistocene group of twisted-horn antelopes *Gazellospira* and *Spiroceros*. The distinction between the several species referred to these genera is mainly based on the horn-core morphology and dimensions, although the material is often too scarce for a certain comparison. In regard to the lower teeth morphology, all the above mentioned forms present three stable characters: primitive p3 sometimes with closed talonid, tendency for molarization in p4, well developed goat fold on the molars. The systematic value of some additional characters such as the presence of accessory external stylids (ectostylid) seems questionable. The studied mandible preserves all the above mentioned significant morphological features. In comparison to *Spiroceros kiakhtensis* from Sjarra-osso-gol, China (BOULE et al. 1928) the studied form is differentiated by its longer premolar row compared to the molars (Tab. 4) and by the less molarized p4, and its missing ectostylid. *Spiroceros peii* from Choukoutien, China (YOUNG 1932) has a less developed goat fold than the Sarikol Tepe form, a more developed hypoconid and entoconid on p3, a less developed entoconid on p2 and a shorter premolar row compared to the molars (Tab. 4). *S. wongi* from Nihowan, China (TEILHARD & PIVETEAU 1930) presents strong ectostylids and shorter premolar row than the Sarikol Tepe form (Tab. 4). The morphology of *Gazellospira torticornis* seems to fit well with that of the studied mandible (PILGRIM & SCHAUB 1939, DUVERNOIS & GUERIN 1989). As a matter of fact, the morphology and dimensions of the Roccaneyra mandible (Rn 129), described and figured by PILGRIM & SCHAUB (1939) are identical to those from Sarikol Tepe, especially in respect to some peculiar characters such as the structure of p3's metaconid, the degree of molarization in p4 and the development of the goat fold on m3 (Tab. 4).

Table 4: Comparison between the Sarikol Tepe (Turkey) *Gazellospira* and other related Plio-Pleistocene forms from Eurasia (data from PILGRIM & SCHAUB 1939; DUVERNOIS & GUERIN 1989; BOULE et al. 1928; YOUNG 1932; TEILHARD & PIVETEAU 1930).

	Gazellospira SGT	*G. torticornis* Roccaneyra Rn129	*Spiroceros peii* Sangan-ho	*S. kaihtensis* Sjara-ossogol	*S. wongi* Nihowan
Lp2-m3 (1)	101.5	107	100	122	101-113
Lp2-p4 (2)	34.8	37	29	36	32.5-35.5
Lm1-m3 (3)	66.24	72	71	86	66-78
		(Coupet=61.5 Senèze=69.0)			
Index (2)/(3) x 100	52.53	51.3	40.8	41.8	45.5-49.2

The reduction of the premolar row seems to be a useful character for the distinction between *Spiroceros* and *Gazellospira*. Thus, and according to the available data, *Gazellospira* is characterized by a more elongated (and therefore primitive?) premolar row comparatively to the molars, than *Spiroceros*. In the three species of *Spiroceros* mentioned above, the index "Lp2-p4 x 100/ Lm1-m3" is smaller than 45 (with the exception of Nihowan spec. 2 of TEILHARD & PIVETEAU 1930, in which this index is 49.2), while in *Gazellospira torticornis* from Roccaneyra as well as in the studied specimen, this index is larger than 50 (Tab. 4).

<p style="text-align:center">Genus Gazella BLAINVILLE 1816</p>

<p style="text-align:center">Gazella sp.
(Fig. 23D-E)</p>

Synonym: 1991. Gazella sp., SEN, p. 251

M a t e r i a l : Horn-core base, SGT-38 (DT base=22, DAPbase=35); horn-core fragments, SGT-39, 40; M1/2 very worn, SGT-45 (L= aprx 13, W=8.2); m3, SGT-46 (L=19.26, Want=7.84, Wpost=7.82); distal part of McIII+IV, SGT-54 (DTdiaphysis=12.94, DAPdiaphysis=12.22, DTdistal-art.=21.35, DAPdistal =16.25)

Description and comparison:

The horn-core is inserted above the orbit and its length could be estimated as 150 mm. The pedicle is short with a shallow and rounded postcornual groove. Relatively deep longitudinal grooves run along its surface. The cross-section is oval at the base, becoming rounded to the top. The index "DTbase x 100 / DAPbase" is about 63. From the available fragments it seems that the horn-cores were slightly curved posteriorly. The stylids of the lower third molar and especially the parastylid are well developed. The morphology of the distal part of the metacarpal (well developed keels, parallel lateral borders) rather indicates an open country inhabitant.

Although the material is insufficient for a certain comparison and conclusion, there is no doubt about its attribution to the genus Gazella. The dimensions of the preserved horn-core basis are similar to those of Gazella borbonica from Europe. The short pedicle and the shallow postcornual groove of the studied form indicate also similarities with G. borbonica. However, the horn-cores of the latter species are more elongated, more strongly curved backwards and smoothly grooved. Several morphological features of the Sarikol Tepe form, such as the short horn-cores, the presence of deep longitudinal grooves, the small post-cornual fossae and the weak curvature remind those of the newly erected species G. emilii BOUVRAIN 1998 from the lower Pliocene locality of Çalta. Their size is also comparable. Another species of similar morphology and dimensions is Gazella bouvrainae (KOSTOPOULOS 1996) from several late Pliocene localities of Greece (KOSTOPOULOS & ATHANASSIOU 1997). BOUVRAIN (1998) distinguished G. emilii from G. bouvrainae on the basis of the absence of deep grooves in the horn-cores of the type specimen of the latter species (locality Gerakarou, N. Greece), as well as the shorter premolar row and the less developed metapodials. Nevertheless, G. bouvrainae and G. emilii could be considered as members of the same gazelle group, in which could be probably included the Sarikol Tepe form.

<p style="text-align:center">Bovidae gen. & sp. indet.</p>

M a t e r i a l : m3, SGT-49 (L= -, Want=8.1, Wpost=7.45)

This m3 on which the talonid is totally broken, is comparable in size to the above described gazelle. Nevertheless, its parastylid is stronger, and it has a well developed goat fold. These two features allow us to distinguish it from Gazella sp. of the same locality.

3. Conclusion

The locality of Sarikol Tepe yielded remains of nine species of large mammals and one rodent. Although poor in number of specimens and taxa, the Sarikol Tepe fauna can allow quite certain biochronologic conclusions. Borsodia has a vast geographic distribution; it is present in the late

Pliocene – early Pleistocene (early Villanyian-early Biharian) faunas of Eurasia, covering the area between northern China and central/northwestern Europe (TESAKOV 1993). The metrical and morphological features of the Sarikol Tepe form are closer to those of the "intermediate stage", indicating a late Villanyian (late Pliocene) age. The presence of the genus in the late Villanyian of Turkey is also mentioned by ÜNAY & BRUIJN (1998). A form close to *Borsodia* is also referred from the latest Pliocene locality of Gerakarou in northern Greece (KOLIADIMOU 1996).

Pliohyaena perrieri appears in the early Villafranchian (MN16 or even top of MN15) of southern Europe and lasts until the late Villafranchian (top of MN 17: localities Senèze-France, Gerakarou-Greece, Slivnitsa-Bulgaria; HOWELL & PETTER 1980, KOUFOS 1992, SPASSOV 1998). At the beginning of Pleistocene (locality Olivola-Italy) the species is replaced by the more advanced *P. brevirostris*. *P. perrieri arambourgi* from Sarikol Tepe, though its particular characters, seems to be more evolved than *P. perrieri* from Gülyazi-Turkey (top of MN 16; SEN & LEDUC 1996) and closer to the later European representatives of the species, allowing it to be of late Pliocene (late Villafranchian – top of MN 17) age. The species was also mentioned from the latest Pliocene (top of MN 17) locality of Kamisli, Turkey (SICKENBERG et al. 1975, SEN & LEDUC 1996).

Eucyon is a newly erected late Turolian-Villafranchian genus, with a great geographic distribution (TEDFORD & QIU 1996). The Sarikol Tepe form presents clear similarities with the Odessa Catacombs *Eucyon odessanus*, whose age determination is quite obscure. Nevertheless, SICKENBERG et al. (1975) listed *Canis* (s.l.) *odessanus* from Gülyazi (Turkey), indicating the presence of this species in the Villafranchian of Turkey. In the more recent (late Villafranchian) localities of Kamisli and Sögütünü a form close to *Canis etruscus* appears (SICKENBERG et al. 1975).

Equus stenonis is a common Villafranchian species, present in most of the south European localities but also in Kazakhstan, Siberia and China (AZZAROLI 1990). The Sarikol Tepe form appears closer to the middle-late Villafranchian subspecies of Europe (*E. s. vireti* from St. Vallier, France and *E. s. stenonis* from Olivola and Matasino, Italy), indicating a similar age. As regards to equids, the Sarikol Tepe fauna seems more advanced than that of Gülyazi, where *Hipparion* cf. *crusafonti* is recorded (SICKENBERG et al. 1975). *Equus stenonis* is mentioned from the late-latest Pliocene Turkish localities of Kamisli and Sögütünü; nevertheless, in the latter one it is associated with *Hipparion* (SICKENBERG et al. 1975).

The twisted-horned antelope *Gazellospira* is another common Villafranchian genus, covering the entire Eurasia. In Turkey, the genus is probably present in the late Ruscinian localities of Çalta and Akçaköy (SICKENBERG et al. 1975, BOUVRAIN 1998), while in the younger faunal assemblages, a form referred to *Spiroceros* appears (SICKENBERG et al. 1975). The Sarikol Tepe *Gazellospira* presents some particular features which are also observed in the Roccaneyra (France) form, dated to the beginning of middle Villafranchian (base of MN 17).

Although insufficiently known and usually confused, *Pliotragus* is a typical Villafranchian genus, known from several European localities. Its presence has never been mentioned in Turkey but it occurs in the late Pliocene faunas of Romania and Bulgaria (DUVERNOIS & GUERIN 1989, SPASSOV 1998).

The presence of *Gazella* in Sarikol Tepe does not bring any biochronologic information. The genus dissapears in the late Villafranchian localities of western Europe but it is still present in the Balkans area (KOSTOPOULOS & ATHANASSIOU 1997) and also probably in Turkey during the middle-late Villafranchian: it is referred from Gülyazi and Sögütünü (SICKENBERG et al. 1975). In the faunal assemblage of Gülyazi two species are present: *Gazella borbonica* and another form referred by SICKENBERG et al. (1975) to "*Gazella*" cf. *sinensis*. We suppose that this second species is more similar to the "*G. emilii – G. bouvrainae* group", in which the

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Sarikol Tepe form could also be placed. The coexistence of these two faunal elements was already mentioned in the middle Villafranchian locality of Sesklo (Greece; KOSTOPOULOS & ATHANASSIOU 1997).

Paracamelus cf. *alutensis* is a particular faunal element of the Sarikol Tepe assemblage. This small camel has been previously considered as an early Pleistocene form. Nevertheless it is present in the locality of Livenzovka (Western Russia, MN 16; BAIGUSHEVA 1971), indicating a more vast chronological distribution. According to the available data, *Paracamelus* seems to be a common element in the Villafranchian faunas of Turkey: it is also present at Gülyazi (*P.* cf. *alexejevi*) and Sögütünü (*Paracamelus* sp.) (SICKENBERG et al. 1975). On the contrary, it has never been mentioned from the Villafranchian of the southern Balkan area (Yugoslavia, Bulgaria, Greece), while it is present in the early Pleistocene of Romania.

Taking into account the above mentioned observations, a late Pliocene (MN 17) age could be proposed for the Sarikol Tepe locality. As regards the local succesion of mammalian faunas, the Sarikol Tepe assemblage could be placed between those of Gülyazi (top of MN 16) and Kamisli, Sögütünü (top of MN 17). It must be noted that the Sarikol Tepe fauna is the first one of this age to be described from Turkey. Moreover, its correlation with the Sinap stratigraphic section and faunal succession increases its significance for the mammalian chronology in Anatolia.

A paleoecological approach seems also to be difficult because of the limited number of taxa and individuals recorded at Sarikol Tepe. The faunal assemblage is rather characterized by the presence of steppe elements such as *Borsodia*, *Paracamelus* and *Gazella*. Nevetheless, *Gazella* and *Gazellospira* are also reported from more closed environments of the "savannah woodland" type. On the other hand cf. *Pliotragus* may be a signal for the presence of "high plateaux" biotopes, while the metapodial structure of *Equus stenonis* rather indicates a soft ground. The exceptional absence of Cervidae is obviously due to the poor material rather than to ecological reasons. Faunas of similar age from the neighbouring areas indicate an environmental mosaic of the present type "savannah woodland", which seems also possible for the Sarikol Tepe case.

4. Acknowledgements

5. References

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